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THE GRASS-LANDS OF NEW ZEALAND.

I. PRODUCTION AND EARNING-POWER.

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THE total occupied area of New Zealand, according to the official statistics for 1916–17, is 42,745,000 acres. Of this area, 4,540,000 acres consist of virgin forest, a goodly proportion of which is likely to be grassed within the next twenty years or so. Over 2,200,000 acres are ranked as barren and unproductive, and, being mainly mountain-tops, river-beds, glaciers, and littoral sands, are likely to remain unproductive. Again, there are over 2,700,000 acres in fern and scrub. Much of this represents more or less virgin country that is yearly being converted into excellent grazing-land, but a proportion represents country that has reverted to undesirable growth after initial attempts at grazing have failed. Deducting the part of the occupied land just enumerated that is used neither for the growing of crops nor the grazing of animals, there is left some 33,300,000 acres on which the whole of the agricultural and pastoral pursuits of the country are conducted.

The following statement gives the approximate acreage devoted to each chief type of crop:—

	Area in Acres.	Percentage of Total Area.
Pastures on ploughed land ..	5,000,000	15·0
Pastures surface-sown	10,200,000	31·0
Natural pastures	16,150,000	48·4
Total grass crop	31,350,000	94·4
Root and green crops	800,000	2·3
Oat crop	560,000	1·6
Total grass-supplementary crops	1,360,000	3·9
Total area devoted to stock-feeding ..	32,710,000	98·3
Cereals (wheat, barley, maize), pulse crops, potatoes, phormium, and fallow land	440,000	1·3
Plantations, orchards, and gardens ..	150,000	0·4
Total crops other than those for stock-feeding ..	590,000	1·7
Total occupied area under utilization	33,300,000	100·0

A proportion of the oat crop is used for human food, but this is more than balanced by the proportion of the cereal and pulse crop used for stock-feeding purposes. The foregoing statistics show the great importance of the grass crop in New Zealand, so far as the area on which it is sown is concerned. It is, however, rather unfair to include the unimproved grass-land, and the following figures give a better idea of the relative importance of the various crops when only the improved land is taken into consideration:—

	Area in Acres.	Percentage of Total Area.
Grass-land sown	15,200,000	90
Grass-supplementary crops ..	1,360,000	7 to 8
Other crops	590,000	2 to 3

Thus, on the improved land of New Zealand, out of every 100 acres 90 consist of grass-land, and between 7 and 8 acres are devoted to supplementary-grass production, leaving less than 3 acres for all other types of soil-utilization. When the whole of the occupied area is considered, only 1½ acres out of every 100 are used for purposes other than the feeding of live-stock.

There are in New Zealand approximately 42,000,000 stock-units. This is arrived at by calculating each sheep as one stock-unit, and each cattle-beast and horse as six stock-units. It is considered that each stock-unit requires per day 24 lb. of grass or grass-equivalent, or, roughly, 4 tons of grass per annum. From this the annual feed-requirement works out approximately at 170,000,000 tons per annum.

If we now examine the area and yield of each crop devoted to the feeding of live-stock the following is the relative position of each crop so far as total yield is concerned :—

	Area in Acres.	Average Yield per Acre.	Total Yield. Tons.
Grass	31,350,000	4·9 tons	153,000,000
Turnips	540,000	15 ,,	8,100,000
Rape and summer forage ..	240,000	8 ,,	1,920,000
Winter fodder*	300,000	4 ,,	1,200,000
Mangels	12,000	20 ,,	240,000
Oats	200,000	15 cwt.	150,000
Oat-straw chaff	200,000	1·5 tons	300,000
Oat-sheaf chaff	360,000	2 ,,	720,000

* Mostly winter cereals fed down one or more times.

Other crops, such as linseed and barley, should be included in part, but the above are sufficient for the purpose. It must be remembered that the figures are almost entirely estimates, but they are in the main fairly correct. In point of fact, 4 tons of grass per stock-unit is really on the high side, as much stock is maintained on less than this amount; but the number of stock-units during the summer of each year is considerably more than 42,000,000, so that the quantity of feed produced probably well exceeds 170,000,000 grass-tons per annum.

In the above table the supplementary feeds may be calculated at about 17,000,000 grass-tons. On this basis grass produces 90 per cent. and grass-supplementary crops 10 per cent. of our live-stock food.

In calculating the yield of grass-land the above table includes both sown and natural grass-land. The natural grass-land of New Zealand certainly does not exceed half a sheep per acre, or, roughly, 32,000,000 tons of grass. In point of fact, I do not think that the natural grass-land has as high a carrying-capacity as half a sheep per acre. This leaves 34,000,000 or perhaps 35,000,000 stock-units that are carried on the sown grass-land and grass-supplementary crops. This means that the improved land used for stock-feeding produces 136,000,000 to 140,000,000 grass-tons per annum, distributed as follows :—

	Area in Acres.	Average Yield per Acre.	Total Yield. Tons.
Grass-land	15,200,000	8 tons	122,000,000
Supplementary crops (as in preceding table)		..	17,000,000

From this the following is deduced in regard to the average production of the areas devoted to feeding live-stock :—

	Grass-tons per Acre.
Total area	5
Total area excluding unimproved grass-land ..	9
Unimproved grass-land	2
Total grass-land	4·9
Improved grass-land	8
Supplementary feeds (average)	13

Each stock-unit has a certain average earning-power per annum. This varies both with regard to the price of live-stock products, and according to whether the stock-unit is derived from sheep, cattle, or dairy cows. It is clear, for instance, from the prices paid for dairying-land that the same amount of feed given the dairy cows will earn more than the same amount fed to sheep. Horses also have a very different earning-value to any other type of stock. Again, a yearly allowance of, say, 28 grass-tons to a cow yielding 300 lb. butter-fat will earn more than when fed to a cow yielding 200 lb. butter-fat. It is thus almost impossible without an abundance of data to fix the earning-power of stock-feed.

For purposes of comparison, however, let us fix a quite supposititious earning-value per grass-ton or grass-ton equivalent. Four shillings per grass-ton, or 16s. per stock-unit, is at the present time a fair annual earning-power per stock-unit where sheep are concerned, but it is too low for dairy cows. However, it can be used here. If the earning-power of a grass-ton or a grass-ton equivalent is 4s., then a grass-ton when fed to stock would always earn 4s. no matter what is the nature of the feed or at what time of the year it is fed, provided prices remain uniform. Of course, grass itself varies in nutritive quality at different seasons of the year, owing to the variation in water-content; but for our purposes a grass-ton of grass is reckoned as a ton of grass containing from 80 to 85 per cent. of water. As there are 42,000,000 stock-units in New Zealand, the annual earning-power of the live-stock per annum can be put down at £34,000,000. Of this amount, grass-land earns over £30,000,000 and supplementary feeds less than £4,000,000 annually. We thus have the following production and values, each grass-ton being valued at 4s. :—

	Tons.	£
Total grass-land	153,000,000	30,600,000
Total supplementary crops ..	17,000,000	3,400,000
Unimproved grass-land ..	32,000,000	6,400,000
Improved grass-land ..	121,000,000	24,200,000

In reality, the amount credited to unimproved grass-land is too high. Calculated on percentages, grass-land earns, roughly, 90 per cent. and supplementary crops 10 per cent. of the total. These percentages will be true whatever figure of value one gives to a grass-ton.

Bringing these figures down to the earning-power per acre we get, approximately, the following :—

Total grass-land earns	20s. per acre.
Unimproved grass-land	8s. ,,
Improved grass-land	32s. ,,
Grass-supplementary crops	52s. ,,

In this theoretical estimate of the earning-power of grass and grass-supplementary crops no considerations of the cost of production are taken into account, as they have no bearing on the gross earning-value of feed in terms of live-stock products.

With regard to earning-power a very remarkable point must be mentioned—namely, that with an earning-power of 4s. per grass-ton hay would have an earning-power of 20s. per ton, a figure which is much below the actual market value of hay. This fact is of very great importance in the study of the grass crop in relation to other types of feed, and requires rather full discussion. Indeed, this fact which has just been deduced is probably one of fundamental importance so far as New Zealand agriculture is concerned.

COMPETING-POWER OF GRASS, HAY, AND GRASS-SUPPLEMENTARY CROPS.

When conditions are exceptionally favourable for grass-development there is in New Zealand no crop that can successfully compete against it under all circumstances, except perhaps lucerne and yellow-fleshed and swede turnips. To compete successfully against grass a crop must cost less per grass-ton than does a ton of grass under similar circumstances. Exceptionally good crops of nearly all the grass-supplementary crops can compete successfully against grass, but when the average crop is considered the net earning-power of a grass-supplementary crop rarely exceeds that of grass.

It has been mentioned that successful competition depends upon the cost of production under similar circumstances. This is the important consideration. Did not grass-land, except under the most favoured circumstances, possess certain grave defects when considered as a continuous whole-year crop, no supplementary crops would ever be grown. In point of fact, if no supplementary crops were grown the grass-lands of New Zealand could not support during the whole year the 37,000,000 stock-units which theoretically could be carried on the grass-land alone. Enough feed—namely, 150,000,000 grass-tons—is produced during the twelve months, but the supply is not even throughout the year. Thus periods occur when the grass-land yields insufficient feed to properly support its average carrying-capacity, and supplementary feed becomes essential. These periods are termed crucial periods, and always coincide with the lowest carrying-capacity points of the grass-land itself.

In this way it can be seen, for instance, that average two-stock-unit country producing 8 grass-tons per annum may produce 6 tons in the summer months and only 2 tons in the winter months; or, in other words, it has a carrying-capacity of three sheep per acre during the summer and only one sheep during the winter. Under such

circumstances the provision of 4 extra grass-supplementary tons during the winter will make the average carrying-capacity three sheep for the whole year; and if this pays better than carrying three sheep for the summer and one sheep for the winter, then the growing of the grass-supplementary crop is a business proposition. If, however, it were possible, in nearly all cases the production of grass itself would be better than the growing of supplementary crops. The earning-value of a grass-ton being the same at any season of the year, such a statement is made clear with regard to all those crops that cannot successfully compete against grass so far as cost of production, bulk for bulk, is concerned.

With sheep, the possibility of avoiding the crucial periods can sometimes be managed by selling off stock and buying in again at other periods. This, however, is not often profitable, as the stock sold is often not disposed of at a figure equivalent to the proper earning-power of the grass they have consumed, and the converse occurs when buying takes place. With cattle, and especially with dairy cows, this method of avoiding crucial periods hardly ever applies.

We are thus brought face to face with a very remarkable fact—namely, that in order to secure the full earning-power of the feed produced on grass-land it is generally necessary to provide grass-supplementary crops the actual earning-power of which is often considerably less than their cost. The case of hay is a striking example. It can only earn between 16s. and £1 per ton with a grass-ton at 4s., and its cost is always greater, but without it the earning-power of all the rest of the grass produced would be diminished. Let us take, for the sake of argument, the case of rape-growing, in which 8 tons per acre is about the average yield. This means that the average earning-power of an acre of rape is 32s. Against this there is the loss of grass—say, 2 tons during the time the rape occupies the ground—so that it does not really earn more than 24s., which is less than the average cost of production. Nevertheless, rape-growing is essential, as its loss is more than covered owing to its securing a full earning-power for grass-land during the rest of the year. If, however, on a farm requiring 100 tons of rape, 100 tons of grass could be grown at the required time, the production of rape would not be entertained.

The position can now be stated as follows: (1.) When grass-land undergoes no crucial periods, grass-supplementary crops are not necessary. (2.) The longer and more acute the crucial periods, the greater will be the necessity for supplementary feed. (3.) When grass-land undergoes crucial periods and no supplementary crops are growing there is a great loss in the earning-powers of the feed produced.

In other words, when sufficient growth is not available on grass-land supplementary crops are successful competitors, but not otherwise. The question of the competitive relation of grass-supplementary crops themselves does not concern us here, except in so much as certain definitely grass-competing crops, such as turnips, simplify general pasture consideration in many parts of New Zealand. Some examples may be given of where the principles above enunciated are in practice.

In Weber County, Hawke's Bay, with a carrying-capacity of 2·4 stock-units per acre, there is 1 acre of supplementary feed to every 600 acres of grass, the yield of grass being extremely uniform during the year. In Waimate West County, Taranaki, although the yield of grass-land does not fluctuate very greatly, the amount required does. This county being almost entirely devoted to dairying, a high summer yield is essential, and 1 acre of supplementary feed to every 13 of grass-land is grown. In Southland, where there is a great fluctuation between summer and winter yields of grass-land, 1 acre of supplementary feed is grown to every 7 of grass. Again, on very low-yielding grass-land little supplementary feed is grown even if the yield fluctuates, and in consequence the full earning-value of all the feed produced is not maintained. On periodical very high-yielding grass-land where crucial periods are experienced grass-supplementary crops are of the utmost importance.

As it can be shown that grass is in almost every instance the cheapest feed that can be grown, the two great problems of pasture study are on the one hand to try and reduce the necessity for the growing of supplementary feed, and on the other to secure grass-land that will produce feed at the cheapest rate. Up to this stage of the discussion grass-land has been considered as being all similar, but there is, of course, a very large number of types differing from each other in many particulars. In a future article some of these types will be studied and some general account given of their formation, management, and economic importance.

In 1915 Mr. W. Ford, of Brookton, Western Australia, obtained a pound of Green's Ruakura oat for testing on his farm. Mr. Green, the originator of the variety, recently received a letter from Mr. Ford, in which he says, "I think the Ruakura oat has a great future in this State; it has beaten any other oat I have grown." A newspaper report accompanying the letter states that last year Mr. Ford got 45 bushels to the acre of the Ruakura oat, while Algerians alongside gave only 15 bushels. Mr. Ford's experience has been that the Ruakura oat is highly rust-resistant, or, as the report has it, "practically rust-proof."

NEW ZEALAND DAIRY COWS.

IMPROVEMENT IN AVERAGE PRODUCTION.

W. M. SINGLETON, Assistant Director, Dairy Division.

IT is approximately three-quarters of a century since the earliest importations of cattle into New Zealand. The first to arrive were Shorthorns, and a few years later Ayrshires were introduced. The Ayrshire crossed with the Shorthorn provided the foundation of our earlier dairy herds. The Jerseys, Friesians, and Guernseys were introduced later, and during the seven decades since the first Ayrshire was imported dairy cattle have been increasing in numbers, until the 1916–17 enumeration (31/1/17) credits our herds with 777,439 dairy cows. The 1911 census showed 633,733 dairy cows, the six-years increase thus being 143,706, or 22½ per cent.

PRODUCTION.

For many reasons it is not an easy task to compile a satisfactory estimate of the yield of the average dairy cow. Not all cows that calve milk the full season, and some cows do not come into milk at all. Dairymen will seldom state the number of their dairy cows above those that are in milk, and sometimes two heifers are counted as one cow. The returns made to the Government Statistician are likely to indicate the position more accurately, but even these, in the writer's opinion, are more likely to be understated than overstated.

Probably the most satisfactory manner of estimating the butter-fat yield of the average dairy cow—in milk and dry—is to calculate the total production of butter-fat for the Dominion. This includes the portions exported as butter, cheese, dried milk, &c., and the quantities of these commodities consumed locally, together with the local consumption of milk, cream, and condensed milk. Figuring on this basis, it is estimated that during the 1916–17 season over 125,800,000 lb. of butter-fat was produced by the 777,439 cows indicated by the Statistician's figures as being in milk and dry. For the season 1910–11 it is estimated that over 90,000,000 lb. butter-fat was produced by the 633,733 cows indicated in that year's census. Between the two periods the increase in the number of cows is 22½ per cent., whereas the increase in the butter-fat produced is over 39 per cent. These figures bear testimony to the improvement in the producing-capacity of the average dairy cow.

On the foregoing basis the average cow for the 1910–11 season is credited with a production of 142·1 lb. butter-fat. The yields had been so improved in the following six years that for the 1916–17 season the credit for the average cow is 161·8 lb. butter-fat. This represents an increase of 19·7 lb. butter-fat, or 13·8 per cent. over the yield of the average cow for 1910–11.

MONETARY RETURNS DUE TO COW IMPROVEMENT.

The 777,439 cows of the 1916–17 enumeration produced last season over fifteen and a quarter million pounds more butter-fat than would have been obtained on the average yield of the 1910–11 cow. As the local consumption in any case receives first consideration regarding supplies, it follows that our exports have been directly increased by the total amount of the improved yield. Much of this extra milk-fat and accompanying non-fatty solids was devoted to cheese-production, for which the suppliers received payment at rates varying up to 24d. per pound butter-fat. Butter-factories paid suppliers an average of more than 18½d. per pound fat for the past season.

Reducing the exports in butter and cheese for the 1916–17 season to butter-fat, the figures show that a little more butter-fat was exported in butter than in cheese. It is conservative to value the increased production per cow for the 1916–17 season at 20d. per pound fat. The value of this increased yield of butter-fat would thus amount to £1,276,000, paid to milk and cream suppliers. Further, this increased butter-fat per cow means more milk, and therefore more by-products, such as whey, skim-milk, and buttermilk. Roughly, these would amount to more than 36,000,000 gallons, and must represent a very material increase in the Dominion's carrying-capacity for pigs and calves.

Moreover, the econonic value of the increase to the Dominion has been greater than these figures represent. In addition to the suppliers' receipts, this extra butter-fat has paid for all labour and other charges incidental to manufacturing and shipping the produce. Much of the extra amount has been paid to labour for services in the dairy factories, in the supply of fuel, timber, transport, and wharf handling. Many of these services are not connected directly with the dairying industry.

An increase in the Dominion's exports of food products due to the keeping of an increased number of cows is commendable, but even more praiseworthy is the increased production due to the improvement of the average dairy cow. Factors are at work in this connection which indicate that a further increase of production per cow will yet result. New Zealand's asset in her dairymen and dairy cows is appreciating more than is generally realized.

SOME FACTORS THAT EFFECT IMPROVEMENT.

The period during which this improvement in the production of the average New Zealand cow has been brought about synchronizes with that during which the cow-testing movement has been developed. The adoption of this work as an intelligent guide to culling out unprofitable producers and selecting the best as mothers for individuals of the future herd has been of great advantage in attaining the improvement now recorded. The culling-out must be accompanied by the introduction of other producers, and it is in obtaining these that the ability of the dairyman is tested.

An increasing number of our owners of crossbred cows are building up their herds by introducing heifers which they have bred and reared. The proportion of these sired by purebred bulls is greater than was the case some years since. The use of purebred bulls of dairy breeds has had a marked influence on the production of our dairy herds, and we believe the certificate-of-record testing system carried out and given publicity by the breeders and the Dairy Division has been the most potent influence at work in increasing the demand for bulls that will assist in building up the quality of our dairy herds. We do not overlook the improvement that has been accomplished in feeding the average cow, but unless an animal has the "dairy temperament" her better feed does not evidence a corresponding improvement in the yield of milk and butter-fat.

In equal environment an increase in the productive capacities of daughters over their dams can only be attained through having them sired by a bull who carries transmissible hereditary factors which represent a dairy strain that is superior to that of the cows with which he is mated. Breeders have evidence of the keenness of dairymen to purchase bulls from C.O.R. cows. Some breeders who have extensively patronized the C.O.R. testing have disposed of all their bull calves before the summer was over. This is quite a contrast to earlier conditions, when sales were frequently difficult to make. Such a healthy state of affairs is tangible proof that more dairymen are appreciating the importance of a good bull, and are recognizing that his dam's record and the records of his sisters or daughters are the best indices to his ability to transmit the necessary factors of improved butter-fat production.

Many herds in our dairying districts average more than 200 lb. of butter-fat per cow, a lesser number average over 300 lb., and in a few cases the average cow of the herd produces 400 lb. butter-fat or more. Those herds averaging 300 lb. fat and more cannot be maintained on a constructive basis unless by wise selection of sires. If sires of exceptional merit are necessary in these good herds the owner of a herd of average cows producing 160 lb. butter-fat may expect to see a greater percentage of improvement by the use of

such a sire, provided the daughters have conditions which will permit of their doing themselves justice as producers.

The work which the Dairy Division has been doing along the line of assisting the owners of dairy herds through C.O.R. testing and cow-testing association effort is surely more than justified by the betterment which is evidenced. The margin between the production of our average cow and that of the better herds is evidence of the great work yet to be accomplished. Economics as applied to New Zealand demand that further improvement be made. It was reported recently that since the beginning of the war the world's live-stock statistics showed a decrease of over thirty-three million head in cattle, sheep, and pigs. This decrease is doubtless becoming greater, and indicates an increasing shortness of all food materials supplied by live-stock. It would therefore be a patriotic as well as a profitable effort for our dairymen to do all that is possible in assisting to make good the deficit.

DANTHONIA ON TUSSOCK-COUNTRY.

A CORRESPONDENT writes deprecating advice given in the *Journal* to include danthonia in the surface-sowing of tussock country, and instances part of the erstwhile Glenmark Estate, in North Canterbury, where a danthonia sward was replaced with English grasses by ploughing—with great benefit to carrying-capacity and stock. Mr. A. H. Cockayne, Biologist, comments as follows on the matter :—

The sowing of danthonia on ploughable tussock country is not advocated, especially on such country as the old Glenmark Estate, which carries English grasses well. On poor tussock country, where English grasses will not hold for more than a season or two, the use of danthonia invariably increases the carrying-capacity. At the present time both in the North and South Islands danthonia has invaded land that is too good to carry a pure danthonia sward, and one of the great problems on such country is to use mixtures that can successfully compete against danthonia invasion. The poor opinion many farmers hold with regard to danthonia is due to contrasting its merits with rye-grass, cocksfoot, and clovers ; but to compare such grasses with danthonia on land where rye-grass and cocksfoot are failures is manifestly unsound. The grasses with which, under those circumstances, a comparison must be made are such as red-top, brown-top, chewings fescue, and ratstail. In most cases it will be found that danthonia is generally preferable to these. On ploughable land where rye-grass, cocksfoot, &c., will form profitable short- or long-rotation pastures before danthonia makes its appearance the latter grass should never be used, and when invasion has occurred the land should be laid down in English grasses again. On unploughable tussock country, carrying from one-quarter to one-half sheep per acre, the advisability of danthonia establishment should always be considered, and on such country a danthonia sward will carry more stock than any other type of permanent grass.

THE WAIPOUA KAURI FOREST.

ITS DEMARCATION AND FUTURE MANAGEMENT.

D. E. HUTCHINS, I.F.S.

WHILE my report to the New Zealand Government on kauri forests and forest management (now in the press) was preparing it became evident that a most important work now facing this country is forest demarcation, and it also seemed desirable for me to leave something on record in New Zealand beyond writings. The demarcation of the Waipoua Forest was therefore authorized, and the work was accomplished on lines which are briefly related and discussed in the following notes.

The Waipoua Forest, situated in Hokianga County, North Auckland, represents the largest and, on the whole, the best of the dwindling kauri areas left to the Dominion. The old boundary of the forest was artificial. It consisted of such area as had been left when adjoining parts were cut off for settlement, together with a number of lots which, though surveyed for settlement, contained such valuable kauri forest that no one cared to pay for the kauri timber before taking up the land.

It should be mentioned that the general idea in forest demarcation is to examine forest lands and settle whether the land is best suited for forestry or farming.* In doing the Waipoua demarcation I had my knowledge of similar demarcation work done in other countries, and the local knowledge of the farming and forest value of this land was supplied by the rest of our party, which consisted of Mr. McGregor, an official timber-measurer in the Auckland District; Ranger Maxwell, who is now in charge of the Waipoua Forest, and has spent a lifetime in the kauri country; his Assistant Ranger; and two experienced bushmen, one of whom is also a farmer.

The demarcation work occupied about a month. As now demarcated the Waipoua Forest is eleven miles long from east to west, and nearly nine miles broad from north to south. The area of the main block of forest is 28,880 acres, and the total demarcated area 29,840 acres. The finished demarcation plan was prepared and the areas taken out in the office of the Commissioner of Crown Lands, Auckland.

* A fuller exposition of forest demarcation will be found in the writer's article, "Scientific National Forestry for New Zealand," published in the *Journal* for October and November, 1916.

The Waipoua Forest was originally purchased from the Natives some forty years ago at a cost of 3s. per acre. Owing to the rise in value of land, and more especially to the rise in value of kauri timber, the present value of the forest works out to at least £317 per acre. This figure represents—(1) present crop of kauri and other timber, valued at about half a million sterling royalty; (2) the funded value of future timber crops, supposing the forest to be now worked as in Europe and in South Africa. The kauri timber in the total just given is estimated at rather over a third of a million royalty value, and the other timber very approximately at about £200,000. Details of these values and calculations are given in my official report previously mentioned.

In laying out the demarcation natural boundaries were followed as far as possible; and where beaconed lines had to be run they were, as is the practice, made as long as practicable, so as to reduce the number of angles. A permanent beacon was erected at each angle, and the bearings of each line taken, the procedure being to include areas on poor soil where the forest was good or was capable of restoration at a reasonable expenditure. Good soil more valuable for farming would have been cut out, but little of this was found. On the eastern side, near the Marlborough Settlement, a small area of burnt forest which it would be costly now to put in order was cut off from the demarcated area.

FOREST-STATIONS AND FIRE-WORK.

In an organized forest the centre of the organization is the "forest-station." Here lives the ranger or working forester in charge of the forest. Much depends on the selection of good sites for the forest-stations. They must be central, and they must be in a commanding position, so as to overlook as much of the forest as possible, in order that at dangerous times a constant watch may be kept against fire.

The fire season in New Zealand may average one-quarter as long as that in South Africa, in southern Europe, or in Algeria, and there may be really dry years only once in six or eight years; but the dry year when it does come in a New Zealand forest may be a very mischievous one on account of the exuberance of the vegetation. This dangerous year must therefore be fully provided for. It is twenty years since there was a bad fire year in the Waipoua Forest. Ranger Maxwell remembers it well. It was a jubilee year for the farmers, but a year of lost opportunity for improving the forest. Strips of forest were burnt where the hot wind drove the fire in. The regrowth forest now averages about 40 per cent. faster in height-growth than a European forest, but it has only a fraction of the

value it would have had if treated by foresters, interplanted, planted, sown, or natural regeneration of good species aided.

While the forest demarcation was in progress I was able to select two excellent forest-stations. A third is required, and a fairly good site was inspected. It may not, however, be necessary to open this at present. The other two are already easily accessible on horseback (one nearly so by cart), and afford views of the kauri forest that space in the *Journal* does not permit me to describe.

It is often convenient to have a permanent nursery near the forest-station. Its labour, and that of sawmills, if there are any in the forest, are then at command of the fire-call. It might be thought that this organization would be expensive. It can be shown, however, to cost less than a mere inspecting and preventive agency such as that employed at present in the Waipoua Forest. Two trained forest rangers would be advisable at Waipoua. The important thing is to get the forest-stations built and the occupants on solid forest work instead of mere police work, hunting gum-bleeders or a rare fire-setter.

FUTURE MANAGEMENT OF THE WAIPOUA FOREST.

In considering the future of the Waipoua Forest two facts stand out: (1) the loss that has been incurred in deferring the working of the Waipoua timber; (2) the large amount of employment that will be afforded in the future development and working of the forest. Like all virgin forests, the Waipoua at present is earning nothing. As soon as the timber crop in the forest is realized and concurrently the forest rejuvenated and put in order by foresters it will start making a growth figure of not less than 100 cub. ft. per acre per year. Most foresters would estimate 150 or 200 cub. ft., but to be on quite the safe side let us say 100 cub. ft. per acre per year of kauri. That timber will be worth when mature at least 2s. per cubic foot as it stands uncut in the forest, or, in other words, the forest will be earning about at least 100 × 2s. = £10 per acre per year.

The farmer thinking of his crops will immediately say, "What is the value of £10 per acre per year at the end of 100 years? Discounted at 4 per cent. it is worth to-day only 3s. 11d.; and, besides, I want money now." But with State forestry things fall out differently. The forest has to be considered as a whole, with young trees, old trees, and trees of all ages. The forest as a whole strikes its balance yearly and arranges matters so that in the long-run the incomings from maturing timber pay the outgoings for the upkeep of the forest. Thus there is no interest charge. The Waipoua Forest, managed as forests are in Europe, will pay its way, more or less, for the next 100 years, and then the country will begin to gather in its £10 per acre per year in perpetuity. In my forest report an approximate

"Balance-sheet for a Normal Kauri Forest" worked out on these lines is given in detail.

The public policy at this moment is obviously to prepare for demobilization, the provision of employment, and post-war conditions generally. Managed on scientific lines, the Waipoua Forest will provide remunerative work to the value of about one million sterling on logging and sawing the timber. Forest development will require further expenditure on buildings, &c., but more especially on roads. The amount that will be required for roads is difficult to estimate, but obviously it would be considerable when one reflects on the network of roads and grassed paths required to provide complete fire-protection and work a modern forest. Much of this expenditure would not be really of a novel nature in New Zealand timber-working, since it would be simply a transfer from expenditure on tramways and waterways of a temporary nature, for one crop of timber, to an expenditure on roads of a permanent character for permanent crops of timber.

The most urgent work at Waipoua is the prolongation of the railway, some five or six miles over or under Oronoa Neck, to the kauri timber. Practically none of the Waipoua timber can come out till this five or six miles is made, and the railway is now up against either a tunnel or a detour ascent and descent to avoid the tunnel. As soon as work is touched at Waipoua will come the need of the railway.

NEIGHBOURING KAURI AREAS.

To the north and east of Waipoua lies a considerable area of forest that is slipping out of Government possession. Close by is the Tutamoe Forest, covering an elevated range for ever famous as the home of the big kauri-tree called "Kairauru" by the Maoris, the recorded biggest timber-tree of the world. Some of this famous forest has been sold, but can be redeemed. A large part was surveyed for sale quite recently. At no great distance is the Puketi kauri forest which, though little more than one-third of the area of the Waipoua, is extraordinarily rich and valuable. Immediately to the north of the Waipoua is the large kauri forest called Warawara. So far this has been protected from destructive working by its inaccessibility, but all that has been said about the loss in leaving the Waipoua Forest undeveloped applies nearly equally to the Warawara Forest. Omahutu and Te Aroha are two other fine State forests of which the demarcation and working is particularly urgent. As a national matter it is urgent that these five kauri forests—Tutamoe, Warawara, Puketi, Omahutu, and Te Aroha—should be demarcated without delay and worked systematically.

TIMBER OR GRASS IN THE WAIPOUA COUNTRY.

In the history of every country there arrives the time in which timber becomes scarce and acquires a value comparable to farm products. In the best parts of Europe we see forestry and farming existing side by side, each earning most on the class of soil for which it is best suited. If the kauri forest can pay its way for 100 years and then give the State £10 per acre per year, how does that compare with the dairying-value of the Waipoua area? That was the first point that struck me as soon as I had made out what the kauri forest was likely to yield in the future. Making inquiries among the farmers in the neighbourhood of the Waipoua Forest, I was astounded to learn that they were earning so little. It seemed, however, advisable to confirm what I had heard with more complete information obtained through the Dairy Division of the Department of Agriculture. Mr. Cuddie, Director of the Division, readily undertook to obtain a special report on the dairying results achieved in the Marlborough and other settlements bordering the Waipoua Forest.

Mr. Cuddie's report was to the effect that owing to the very wet climate it is difficult to get a good burn, so that the ash fertility usually obtained in burning the forest is only partially secured. Then comes the leaching-out of the soil and its deterioration. A sub-report by Mr. G. M. Valentine, Dairy Instructor, Auckland, stated as follows: "After the first year or two the finer grasses run out, giving place to the plantain, which grows very quickly, and to pennyroyal and various other weeds. Enclosed is a table showing the yield of butter-fat per cow for the year 1915–16. These figures have been taken from the butter-factory books, and although the rate of payment is over 1s. 3d. per pound of butter-fat the return per cow is very low. In most cases only about 100 acres of each section have been felled and grassed, though it is over twenty years since the land was taken up. The return per acre from the grassed area is under £1 5s."

The figures accompanying the report and information furnished by the Lands Department show that eleven farmers engaged in dairying with a total holding of 2,214 acres had 1,510 acres grassed, on which they ran 192 cows yielding butter-fat of a value of £1,601. The 2,214 acres taken up were therefore giving a dairying return of about 14s. 5d. per acre, and the average earnings of the eleven farmers was £145 11s. yearly. This is no more than the value of their labour at ordinary New Zealand rates; beyond affording the farmers a bare sustenance the soil yielded nothing.*

* Present prices of butter-fat would give a somewhat higher return, but the 1915–16 payment quoted may be regarded as probably a fair after-war average.

What this land would yield as cultivated kauri forest is discussed at length in my report. Briefly stated, Waipoua land occupied as cultivated forest would give present employment at the rate of an expenditure of £984,000 over the whole forest (or £32 16s. per acre) for timber work and milling. To this has to be added expenditure on roadmaking and regeneration (natural and artificial), together with the cost of buildings and local forest officials. Some fifty years of light employment follows, with little more than the timber-working of thinnings and the upkeep of roads; the latter, being mostly for roads grassed and grazed, is light work. The forest all these years is making timber at the rate of about 100 cub. ft. of kauri per acre per year (as well as other timbers), but the bulk of this is not yet mature.

The following statement brings the figures together; it shows the comparative value in money-yield and close settlement of farming and forestry at Waipoua, taking dairying as the best and most intensive farming industry, considering only the dairy-farmers who have succeeded in establishing themselves, and quoting the Dairy Division's figures for their earnings:—

	Holding per Family.	Average Yearly Wages earned.	Yield of Land after deducting Labour, per Acre.
FOREST.	Acres.	£ s. d.	£ s. d.
Normal yield in perpetuity after eighty to one hundred years	75	150 0 0*	10 16 0
DAIRYING.			
Eleven farmers remaining after twenty years	201	145 11 0	Nil.

* With house free or at moderate rent, free firewood, and grazing; or life tenants on small holdings.

Waipoua is too wet a country for either sheep or fruit to have much chance against forestry. Fruit-country the world through is more or less dry country. All the sheep I saw near the Waipoua Forest were two pet lambs. Opinions were divided as to the ultimate success of sheep in so wet a climate, the general opinion being that they might ultimately succeed, but that dairying was at present more profitable and might remain so always. Nearer the coast, where the climate is drier, good flocks of sheep were seen. Farmers say that the Waipoua area would furnish rough cattle farms cut up into lots of 1,000 to 2,000 acres. This would not compare with forestry.

It is evident that at Waipoua, considering both money returns and close settlement, there is little besides dairying and agriculture to set against cultivated kauri forest. The only piece of agricultural land at Waipoua, a white-pine swamp near Ranger Maxwell's residence, was demarcated out of the timber area.

STRAWBERRY-CULTURE.

W. H. TAYLOR, Horticulturist.

[Articles have from time to time appeared in the *Journal* giving advice to strawberry-growers—more particularly beginners. It has now been found advisable to prepare a more comprehensive article, bringing the information right up to date. Mr. Taylor has been somewhat handicapped by the necessity, owing to space restrictions, of curtailing his matter as much as possible. Nevertheless the article will meet a very decided want, frequently expressed by growers.—*T. W. Kirk, Director, Horticulture Division.*]

INTRODUCTION.

THE increasing importance of strawberry-culture in New Zealand appears to warrant a review of the various methods of cultivation, and conditions and circumstances affecting the plant. Difficulties are encountered that so far have not been overcome. In some cases the plants fail to set fruit, and this has been attributed to self-sterility in the variety. Investigations show, however, that such is usually not the case; blossoms of nearly thirty varieties have been examined, and all possessed the organs for self-fertilization. An American authority says that all European varieties are self-fertile; and I may add that most recent American varieties are also, though formerly that was not the case. It is evident that failure to set fruit must be due to some other cause, such as unsuitable soil, or lack of drainage, or fertilizing substances being lacking in the soil.

Again, a large number of plants die suddenly—from causes that have not yet been discovered. In America, where thousands of acres are planted with strawberries and special study has been given to strawberry-culture, similar troubles are sometimes experienced. The cause is variously surmised as weakening of varieties, changes of weather, or loss of roots during winter, while fungoid disease of the roots has been suspected. But nothing is really known, and investigation is difficult. The mere fact that fungoid growths are found on the roots by no means proves that they were the cause of the death of the plants; they may merely have occurred because of the death of the plants. It is suggested that deaths may occur from loss of roots during the wet season. Stagnant water will destroy roots, and the weakened rootstock may be unable to maintain the foliage under stress of dry weather and hot sunshine. Every experienced horticulturist knows that a plant may grow well in a moist atmosphere, and yet collapse at once if placed in a dry and more sunny position. The explanation is that in a moist

atmosphere there is less evaporation of moisture from the leaves. Roots are formed in sufficient number to feed the plant while it remains in the moist atmosphere, but they may be quite unequal to the task of making good the loss by evaporation. These principles apply to all plants, and the trouble with the strawberry may largely be of this nature. The habit of the plant in regard to its root-system is an important thing to know, as cultivation must be in accordance, or the best results will not be obtained.

I may here say that the strawberry is a plant that needs intelligent attention all the year round; unless it gets that attention success can only be of a partial character.

GENERAL REQUIREMENTS.

Good drainage is a *sine qua non* of strawberry-culture. If the plants are in the ground during winter a waterlogged state results in loss of roots. Soil that is waterlogged in winter is cold in spring, and consequently not in a state that will promote quick root-action, which is highly important with spring-planted strawberries. In consequence of the warmth of our climate in spring a cold soil will at that time result in a great disparity of temperature between root and top, and a slow start will be made by the plants.

Perfect drainage is necessary for another reason. Fertility depends on the action of certain microbes in the soil, and if these microbes are not active there can be no fertility. Even artificial manures are valueless without active microbes. A certain degree of heat, the presence of air, and perfect darkness is necessary to these organisms. If the soil is full of water there can be no air in it, and it will be too cold. As the microbes require darkness, they cannot work within a few inches of the surface. Deep tillage is therefore necessary as well as drainage.

The maintenance of an open surface is of equal importance, both to admit air and to preserve moisture. It should be understood that the strawberry is a surface-rooting plant. The roots never penetrate deep into the soil, and do not reach much beyond the spread of the foliage. This serves to emphasize the importance of perfect tillage and the maintenance of a good rooting-medium around the plants. The crop of fruit is produced in a very brief period of time, and the demand for plant-food is thus sudden. The supply of fertilizers should therefore be readily accessible to the roots, and should be in excess of the actual requirements of the crop of fruit, so that finding sufficient may be easy. What is left over will benefit the plants in their later growth or, if the strawberries are turned under, any crop that may follow. It will not pay to neglect the plants during summer. The finest crops are produced in private gardens, which proves the value of constant attention. As already indicated, strawberry-growing is an all-the-year-round occupation.

THE SOIL AND ITS PREPARATION.

Many classes of soil can be made to produce good strawberries if treated in a proper manner. Stiff clay is unsuitable, as the surface soil could not be kept in the condition in which the roots could work freely. A very sandy soil dries out too rapidly, particularly as straw-

berry-roots are near the surface. The best soil is a fairly heavy loam, friable in character. The best strawberries in Britain are said to be grown in the neighbourhood of Edinburgh on a heavy clay loam, overlying a bed of gravel.

Whether subsoiling is advisable should be decided by the character of the soil; usually it is required. After ploughing, the usual steps should be taken to break up the furrow and bring the surface soil to a fine tilth. If the mechanical condition of the soil is not good a green crop should be sown and ploughed in before planting strawberries. This should be done if the soil is deficient in humus, even though otherwise in a suitable condition. Stable or farmyard manure would answer the purpose better, but is rarely available. If the soil is poor it will be advisable to apply artificial fertilizers; the increased bulk of the crop will pay for this.

Lime should not be applied to strawberry-ground, as it is considered that the strawberry requires an acid soil. For the same reason any superphosphate used should be acid—not basic super. Wood-ashes are useful, from their potash-content, but as they contain also a proportion of lime they should not be used in large quantities. Leguminous plants turned in are valuable because they add nitrogen to the soil, and obviate the necessity for large applications of nitrogenous manures, which tend to promote too much leaf-growth and to make the fruit soft, and so spoil it for distant markets. With the exception just mentioned, the ploughing-in of green crops should not be regarded as manuring the land, as they do not return any more potash or phosphoric acid (both of which are necessary) than they take from the soil.

Strawberries should not be grown more than two or three years on the same ground without an interval, as the soil becomes what is known as "strawberry sick."

PLANS OF ROTATION.

The most common rotation in America is clover, potatoes, and strawberries. A one- or two-year clover crop that has been manured is turned under, and the land planted with potatoes. When the potatoes are dug the land is sown with rye-grass, crimson clover, or hairy vetch. This crop is turned under in winter or early spring, and strawberries planted. Another plan is to manure the land and sow rye-grass in the autumn. In spring the land is ploughed and potatoes planted. When the potatoes are dug cow or partridge peas are sown. If these make quick growth they are ploughed under and the ground sown in rye; if not, the peas remain until spring, and are then ploughed in. Planting of the strawberries follows.

PLANS OF PLANTING AND TRAINING.

There are many plans for setting out the plants. The one selected should be that best suited to the condition of the soil and the habit of the variety in the locality in which it is to be grown. This can be determined only by experience. The single-row system is best for extra stiff land, as with the latter it is necessary to work the soil close up to the plants. Soil that is naturally friable can be planted in accordance with any of the plans detailed later. In many cases the plants have to be renewed each year. When this is effected by the usual method of replanting the crops must be comparatively small. I am aware that

to some extent this is compensated for by close planting. The opinion is advanced, however, that the spaced-row method would be more profitable, as the plants would not be transplanted. They would make larger plants the first season and consequently produce larger crops.

Hill or Stool Planting.—The plan most common in this country is that which in America is termed "hill" or "stool," which means that the plants first set are left to fruit one or more years, all runners being removed. The plants are set out at a distance apart in the rows that previous experience has shown to be best—the distance between the rows being sufficient to allow of cultivation—varying from 30 in. to 40 in. This plan is seldom adopted in America, but is the best for heavy

FIG. 1. SINGLE HEDGE-ROW.

land and where weeds are troublesome. A variation of this plan sometimes adopted is to plant in double rows. Two rows are planted at from 6 in. to 18 in. apart, with a wide space between each double row. The disadvantages of this method of planting are that the plants suffer more from drought than under other systems, because the roots are formed high up (referring to second and later years), and they are more liable to be lifted by frost. Both troubles are to some extent overcome by drawing soil from the spaces up around the plants, and more effectually in small cultivations by mulching with stable manure.

Hedge-row Planting.—This is the plan most favoured in America, and has obvious merits. The hedge-row may be single or double. The double row may with equal propriety be termed triple, as, together with the rows first planted, triple rows are formed, though only two rows are of young plants.

FIG. 2. TRIPLE HEDGE-ROW.

To form the single hedge-row the plants are set 18 in. to 24 in. apart, according to habit of growth. Two runners from each plant are set by hand when ready, and when established they are separated from the parent plant. No other runners are allowed, all being pulled off as soon as formed. The result by the end of the season is a row of strong plants 6 in. to 10 in. apart. (See Fig. 1.)

The double hedge-row is a replica of the single, except in the arrangement of the young plants. (See Fig. 2.)

The Spaced Row.—This is represented in Fig. 3. It will be seen that it is similar in principle to the hedge-row. Sometimes secondary runners are allowed to form on the first runners set. These are set in the open spaces until the whole space in the rows is filled with young plants about 6 in. apart. The spaced row is considered more economical to form than the hedge-row, and the yield is larger.

Matted Rows.—There are modifications in this system, chiefly in respect to width of row. A row that is less than 15 in. wide is termed "narrow." The narrow row is in America the most popular method of training matted rows. The matted row differs from the spaced row in that the runners are not set, but are left where they take root, no regular distance apart being aimed at. But in the end the main difference is that the runners set themselves and are thinned out in autumn after they have rooted.

The Broadcast or Matted Row.—In this system there is no restriction of runners. They root where they will till the whole surface is matted. This system is now rarely used.

FIG. 3. SPACED ROW.

INTENSIVE CULTURE FOR SMALL GARDENS.

For these conditions beds can be marked out to hold four rows, and the plants set 12 in. apart each way. A path 2 ft. wide is left between the beds. Beds are 4 ft. wide, which allows 6 in. between the margins and the outside rows. Another plan is to mark out beds 5 ft. wide, with a 2 ft. path between. The plants are put in 1 ft. apart, beginning in the middle. This will give five rows to a bed, with 6 in. between the path and the outside rows.

In both these plans all runners should be kept cut off. Each season, when the plants have done bearing, earth should be ridged up around them, taking it from the paths, thus giving new soil to the crowns, from which the roots start. Plants will continue to bear year after year without renewing, beds nine years old being reported as still producing full crops. Heavy manuring and fertilizing is necessary, for which this system is particularly adapted.

FERTILIZERS.

A high authority states, "Analysis of the soil is useless, as the requirements of all varieties are not the same; experiment alone can show what a variety needs." The fertilizers previously mentioned are

such as are in general required, but proportions must be arranged to suit circumstances. It may be at once said that stable manure is always valuable. Plans for growing green crops for supplying humus and nitrogen when stable or farmyard manure is not available were detailed earlier.

Nitrate of soda is a good spur for lagging growth. Plants that grow freely do not require this spur, but if they appear reluctant to start freely an application of the nitrate is likely to effect the required change. If growth is satisfactory nitrate should not be applied early, as it tends to induce a too luxuriant leafage; it should be given when flowering begins. Applied at that time it is calculated to increase the crop to the extent of from 500 lb. to 1,000 lb. per acre. Two hundredweight per acre is sufficient when animal manure is given, and 3 cwt. without animal manure. Nitrate of soda and sulphate of ammonia are chemically similar, but the nitrate is quick in action, and therefore peculiarly suited to strawberries, where the demand is sudden and continues only for a short time. Sulphate of ammonia is slow in action, and therefore not so suitable. It is for this reason that the sulphate is more valuable than the nitrate in potato-culture, where it is required over a longer period. The two should not be used together, only one being required for the respective purpose. It should be understood that all the nitrate will be used up, and that none is left in the ground for a future crop. This also serves to emphasize the advice not to give too much; an overdose spoils the fruit as well as engenders a too luxuriant leaf-growth. When the weather is dry nitrate of soda may be given in liquid form. The proportion recommended is 1 oz. in 3 gallons of water, giving 1 pint to each plant.

The following fertilizer mixtures are recommended for use according to varying conditions:—

No. 1 (when no stable manure is used): Nitrate of soda, 100 lb.; superphosphate, 1,000 lb.; muriate of potash, 400 lb.; applied before growth begins. In addition, nitrate of soda at the rate of 100 lb. to 300 lb. per acre when the plants are in bloom.

No. 2: Raw ground bone, 500 lb. to 800 lb.; superphosphate, 500 lb. to 800 lb.; muriate of potash, 400 lb.; applied before the plants begin to grow. In addition, nitrate of soda at 100 lb. to 200 lb. per acre when the plants are in bloom.

No. 3: Dried blood, 400 lb.; bone-meal, 1,200 lb.; sulphate of potash, 400 lb.

These mixtures are applied at the rate of from 600 lb. to 1,200 lb. per acre, according to the quality of the soil. The additional dressings of nitrate of soda should be considered separately and applied per acre as stated.

PLANTING.

The time for planting should be ruled by local conditions of soil and climate. In some places autumn planting is necessary, but this may probably be regarded as a disadvantage, as the soil lies inert through winter; and it is advisable to keep it stirred till the last possible moment. Late spring planting is bad, the plants not having time to establish themselves strongly before the cropping begins. Where possible, early spring is the best time to plant.

The soil should be well broken up, and the surface worked fine and rolled. If the soil is very light or sandy the entire surface should be rolled again after planting—plants and all.

Modern practice in planting is quite different from that formerly in vogue. It is not now considered necessary or right to preserve all the roots and spread them out when planting. The purpose of the roots is to keep the plants alive while new ones are formed from the crown, which are the roots that are wanted. For light or sandy soil the roots are left longer than for heavier or moist soil, but are always reduced, the extent of the shortening varying from one-third to three-fourths. The method of shortening the roots is to take a bunch of plants of convenient size, lay the roots on a block of wood and cut them through with a tomahawk or some similar tool. The plants are then handled singly, and all the old leaves cut off.

Planting is done with various implements. Those most frequently employed are a short-handled hoe and a spade. When a hoe is used the planter drives the hoe into the soil, pulls it toward him so as to make an opening beyond it, inserts the roots in the opening, withdraws the hoe, and gives a smart punch with the head of the hoe to firm the soil about the roots. The operation with a spade is similar, except that the soil is made firm by treading it. The depth to plant is such as will leave the crown of leaves and buds just clear of the surface. Care should be taken not to double up the roots. The lines for planting are made with a marker. The plants may be dropped by a boy, who can keep two planters going. The plants should be kept under a damp covering, and not be dropped much ahead of the planters.

CULTIVATION.

The soil may be kept stirred to a maximum depth of 6 in. between the rows, but never nearer than 2 in. to the plants. The depth of working should depend on the weather and the state of the soil—deep in wet weather and for damp soil, and grading off to a couple of inches when soil and weather are dry. No cultivation should be done while the plants are in flower, as dust on the blossoms affects pollination and results in malformed berries.

RUNNERS.

Plants should not be allowed to make runners until fruiting is over. Some growers cut off the first five that show. Runners in the first place take their sustenance from the plants, and would affect the fruit crop and later the parent plants. The latter should recover from fruiting before bearing runners. Late-formed runners should never be planted, as the crowns are not sufficiently matured, and they would give but little or no fruit the first year. Runners should not be taken from old plants, the vigour of young plants being required to produce fruitful runners.

POLLINATION.

In the first part of this article it was stated that all European and most American varieties are capable of fertilizing themselves. Most modern varieties have hermaphrodite flowers—that is to say, they have both stamens and pistils. In modern language these are termed "staminate" flowers, which indicates that there are sufficient stamens

to effect pollination. Those that have no stamens are termed "pistillate," and such flowers are incapable of self-fertilization. Both kinds are shown in Fig. 4. Fertilization may be prejudicially affected by frost destroying the organs, possibly by a deluge of rain, and certainly by a waterlogged state of soil.

FIG. 4. ON LEFT, PISTILLATE BLOSSOM. ON RIGHT, STAMINATE BLOSSOM.

MULCHING.

Stable manure of a littery character makes the best mulch, but is not generally procurable except for small plantations. It should not be applied during winter, as it tends to keep the soil cold. Pine-needles are extensively employed and prove satisfactory. Mulches should be applied before flowering begins. A good mulch helps to keep the surface soil from crusting over. Where no mulch is applied the surface soil must be kept loose between the plants. This is better done by throwing in a little loose soil from between the rows than by stirring the surface.

FIELD-DAY AT THE RUAKURA APIARY.

THE third annual field-day of the Waikato Beekeepers' Association was held at the Ruakura Farm of Instruction on 13th February. Over two hundred people were present from all parts of the Auckland District, and the gathering was a successful one in all respects. The following programme of addresses and demonstrations was carried out during the day: "Elementary Instruction in handling Bees," by Mr. Trythall and the Apiary cadets; "An Ideal Brood-chamber," Mr. J. S. Cotterill; "General Outline of Work at the State Apiary," Mr. Trythall; "Preparing Honey for Export," Mr. E. A. Earp, Apiary Instructor, Dunedin; "Demonstration of Foundation-making," officers of the Department; "Demonstration of Steam Knife and Cappings Matters"; "An Effective Method of dealing with Foul-brood Combs," Mr. C. S. Hutchinson; "Swarming and its Control," Mr. F. A. Jacobsen, Apiary Instructor, Wellington; "Judging by Grading," Apiary Instructors; demonstrations by Mr. Miller.

AGRICULTURAL EDUCATION.

TEACHERS' FARM SCHOOL AT RUAKURA.

An educational gathering taking the form of a teachers' farm school was held at the Ruakura Farm of Instruction during the week 28th January to 2nd February last. The school was organized under the auspices of the Auckland Education Board by Mr. J. P. Kalaugher, Supervisor of the Manual and Technical Branch, in co-operation with the Fields Division of the Department of Agriculture, supported by other officers of the Department. Close on a hundred teachers attended the school. As many as possible were quartered at the farm, but the larger number found living-accommodation in the neighbouring town of Hamilton, with which a special motor-bus service was established. All had the full range, in any time available, of the extensive and many-sided Ruakura establishment, with its seasonal operations in progress, including wheat harvest.

The course of lectures, a number of which took the form of practical talks or demonstrations in the open, by officers of the Department of Agriculture, comprised the following: Forage and Root-crops; Soil-fertility and Plant-nutrition (J. Brown, Director, Fields Division); Shorthorns and Jerseys; Pests and Diseases; Plant-propagation (A. W. Green, Manager, Ruakura Farm of Instruction); Pastures (A. H. Cockayne, Biologist); Beef Cattle; Draught Horses (A. Grant, Live-stock Husbandman); Dairy Work (W. Dempster, Dairy Instructor); Orchard Work (L. Paynter, Orchard Instructor); Potatoes and Potato-culture (J. Beverley, Assistant Agriculturist); Apiary Work (A. B. Trythall, Apiarist); Nursery Work (T. B. Roach, Horticultural Overseer); Poultry-management (E. C. Jarrett, Poultry Overseer). Addresses were also given by Mr. E. Clifton on Agricultural Education in the United States of America, and by Mr. E. C. Banks on Friesian Cattle, both these gentlemen being well-known authorities in their respective spheres.

A course of evening lectures was given at Hamilton, as follows: Conversion of Rocks into Soil (E. K. Mulgan, Chief Inspector of Schools, Auckland); Nature-study in Schools (M. McLeod, Inspector of Schools); Agricultural Education in Schools (G. Pitcaithly, Inspector of Schools); Afforestation (S. I. Clarke).

By general consensus of opinion the farm school may be recorded as a distinct all-round success. At the same time, experience was

gained which will be useful in effecting improvements at various points on future occasions. Various aspects of the school and agricultural education generally are dealt with in the contributions which follow.

THE FARM SCHOOL AND THE RURAL TEACHER.

J. BROWN, B.Sc., N.D.A., Director of the Fields Division.

THE convention of teachers for the purpose of engaging in the study of agriculture and agricultural science is not altogether a recent development in New Zealand. In 1908 such meetings were held regularly at Timaru, and were supported by the officials of the Canterbury Agricultural College, including Professor Lowry (then Director of the Lincoln institution), Mr. Gray, Chemist, and Dr. Hilgendorf, Biologist. Courses of instruction in agriculture for teachers have also been organized in most of the educational districts of New Zealand by the agricultural instructors of the several Education Boards.

But in one or two very important features the recent teachers' farm school at Ruakura differs from all previous efforts to more completely equip the rural teacher for the discharge of his true function. In the first place, the teachers' classes hitherto carried out have been more or less spasmodic and discontinuous in character. Secondly, the classes have been held in the towns, and at best served as a laboratory and lecture-course introduction to the science and practice of agriculture. Again, these classes lacked the stimulation afforded by the number of experts and specialists of the Department of Agriculture who took part in the farm school at Ruakura. These features—the constant association of the teachers over a continuous period and the interchange of ideas thus permitted, the farm atmosphere and environment, with its ample provision of stock, crops, implements, &c., for observation and practical instruction, and the association with men whose life-work is concerned in particular phases of agriculture—mark the Ruakura school as something altogether unique.

A little consideration will suffice to emphasize the special value of these contributing factors. It must be recognized that if the teacher is to play any really effective part in fostering agriculture through education his personal equipment must be very thorough, broad, and sympathetic. It is not enough that he should have gleaned from book or class-room studies a nodding acquaintance with the fundamental sciences in their relation to agriculture. The teacher, more than any other individual in a community, should be thoroughly conversant with the affairs, problems, and

aspirations of the people among whom he works. In other words, the modern view of the teacher's position is that if he confines himself to imparting to pupils in a class-room certain standardized and stereotyped subjects of a curriculum his value as a contributor to advancing civilization must be of a comparatively low order. The teacher's mission is just as much with the adults of a community as with the children in his immediate care. As indicated, before he can become a real teacher he must be a live member of the society in which he resides. The rural-school teacher must therefore cherish all progressive ideals, and must enter into the life and work of his community with fullness and eagerness before his work as a teacher can be claimed to be an effective force.

From this point of view it is coming to be felt more and more that the merely pedagogic aspect of agricultural education should be relegated to the background, and that the facts of agriculture cannot be studied in too direct a way. Lessons should be drawn from the farm itself by constant intimate touch and observation, and in doing so the teacher will find that the facts of science considered in the light of farm practice will through him find readier acceptance and application. More important still, the teacher will discover that so far from merely giving instruction in certain remote ideas under the name of agriculture, he will be able to illuminate the whole practice of farming, arouse enthusiasm therefor, give inspiration to his pupils, and imbue them with a sense of the dignity and desirability of agriculture as a calling. As already stated, the Ruakura school has attempted to contribute to these aims by providing the varied and comprehensive phases of farming in actual operation as they exist at the Ruakura Farm of Instruction by bringing instructors, practical farmers, specialists, and teachers together on the spot, thus establishing a community of interest between the affairs of the farm and school, on the one hand, and the Governmental agencies operating in agriculture and in education on the other.

During the course of the school it was made amply evident that the interests of many of the teachers were not at all narrowly scholastic. There was a marked absence of any tendency merely to absorb academic knowledge, or towards any formal presentations of agricultural science. On the contrary, to many of the teachers agriculture and its problems were quite evidently real and vital issues. With such a spirit and incentive actively at work during the progress of the school there could be little doubt that the teachers would carry away with them to their schools and districts an extended knowledge and a fortified zeal. The conse-

quence of this will be that these teachers will approach the year's work among their pupils and enter into intercourse with the farmers of their district in a new spirit of inquiry and helpfulness, and that this tendency will be cumulative as successive farm schools are held.

It may be pointed out that the influence of such periodical schools would be far greater if during the earlier stages of their teachership opportunities of extended periods of residence and participation in the work of some such institution as Ruakura were given to the teachers. Indeed, it would be a great gain if a schools branch were established at such an institution or institutions to keep in touch with the teachers in this phase of the work, and to issue periodical bulletins and other literature bearing upon nature-study and agricultural teaching in schools, according to the system followed at some of the Canadian and American colleges. It would not be difficult to co-ordinate the Government agencies concerned to this end. Notwithstanding the spirit of co-operation that has prevailed as between Departments, Boards, instructors, and teachers, it cannot be said that our machinery for agricultural education is perfectly adjusted. This phase of the subject, of course, cannot be fully dealt with here. Suffice it to say that the Department of Agriculture would welcome any well-considered proposals for the furtherance of agricultural education and the establishment of a more definite relationship between the various agencies concerned.

REVIEW BY THE ORGANIZER.

J. P. KALAUGHER, Supervisor of Manual and Technical Branch, Auckland Education Board.

I HAVE always held the opinion that there should be active co-operation between the Department of Agriculture and the Education Department and Education Boards in the matter of agricultural education with regard to the instruction not only of school-teachers, but also of farmers and the general community.

I therefore recommended the Auckland Education Board to authorize me to arrange a teachers' farm school at Ruakura, and to ask the Minister of Agriculture and the heads of his Department to give their assistance in carrying out the scheme. The Minister and his officials having given their consent, steps were taken to arrange the gathering. With the help of our instructors of agriculture I compiled a list of teachers who had taken an active interest in school-garden and elementary agriculture work at their schools. These teachers were

circularized asking if they would attend Ruakura Farm for one week, the Education Board undertaking to provide free transit for them on the railways. (The Board later on decided to pay the steamer and coach fares of those teachers from places not served by the railway.)

I expected that some fifty or sixty teachers at most would be able to attend, but a very much greater number applied, and from these ninety teachers were selected. It was thought advisable not to exceed that number, and as a result many applications had to be declined.

A time-table was drawn up, and the teachers were divided into three parties, with the Supervisor and Messrs. R. P. Connell and J. W. Hadfield, instructors in agriculture, each in charge of a party. Attendance at all lectures and demonstrations was required. The time-table provided for five and a half hours' work each day at Ruakura, and also for evening lectures in Hamilton. About twenty of the teachers camped on the farm, the remainder securing accommodation in Hamilton.

The farm school has demonstrated that school-teachers are extremely desirous of making themselves acquainted with the latest developments in agricultural matters. The teachers who attended had to give up a week of their summer holidays, and many, I know, attended at considerable personal inconvenience. All were very satisfied with their experiences at the farm school, and are anxious to be allowed to attend again next year. I have been extremely gratified at the interest aroused in agricultural education. Among the teachers who attended were many who have had a long experience in agricultural matters, not only in the teaching of agriculture in schools but also in practical farm-management.

Among the points to be noted for future classes are: (1.) It is desirable that only teachers who have shown by their work at their schools that they are keenly alive to the value of agricultural education should be permitted to attend. (2.) The time-table for this school was too full, and, although it was faithfully adhered to, the experience gained showed that attendance should be compulsory for all at certain lectures and demonstrations only—*e.g.*, at such as "Soils and their Treatment," "Plant-nutrition," and "Manures and Manuring." Teachers should be allowed to select the others at which they wish to attend, provided, of course, that each teacher should be required to attend for a specified number of hours. A reasonable amount of free time should be allowed, so that each teacher could spend it in observational work in the subjects—*e.g.*, dairy, poultry, bees, nursery garden, or orchard—that he was particularly desirous of acquiring information about.

The best means of enabling teachers to get fuller information about the many phases of the farm-work would be to make residence at the farm compulsory during the school. Then the time not

occupied by formal work could be spent in observation on all parts of the farm. At present there is no building available at Ruakura to provide lodging for a large party of visitors. At a recent meeting I laid before the Auckland Education Board a scheme by which suitable buildings could be provided. The proposal is, briefly, to erect a dormitory to accommodate thirty-four men, and another building consisting of a dining-room and cookhouse. The Board authorized me to get tentative plans prepared, and a committee was set up to deal further with the matter. It is proposed to lay definite proposals before the Department of Agriculture, and it is confidently anticipated that the Auckland Education Board, the Seddon Memorial Technical College, the various High School Boards, and the New Zealand Farmers' Union will all contribute generously towards the cost. Such buildings would not only be used for teachers' farm schools and for parties of agriculture pupils from the secondary schools, but also for farmers' classes.

With regard to the farmers, I am going to arrange, subject to the consent of the Department of Agriculture, for classes to be held at Ruakura during the slacker time of the farmers' year (May to August), each class to last for a week, and those attending it to reside on the farm.

RUAKURA HOMESTEAD FROM THE DRIVE.

THE CONTRIBUTION OF SCIENCE TO AGRICULTURAL EFFICIENCY AND DEVELOPMENT.

A. McTAGGART, M.Sc.Ag., Agriculturist, Fields Division.

How many of those whose daily avocation is directly or indirectly connected with the land ever seek to ascertain by what numerous ways science has come to the aid of agriculture, the great primary industry of New Zealand? We are too used to the "taking for granted" attitude in connection with this universal occupation to trouble ourselves to inquire as to the primary causes—often involving patient exacting scientific research, discovery, and laborious practical application of discovery—which led up to our automatic adoption of methods connected with agriculture. Science has indeed contributed in a colossal manner to practices of modern agriculture. It is truly responsible, in many lands, for the material prosperity enjoyed to-day by those countries. What, we may ask, for instance, would be the economic condition to-day of New Zealand were it not for the material aid of science in discovering and perfecting the refrigerating process? Among the numerous achievements of science that have materially assisted, and in some instances revolutionized, agriculture, those mentioned in the following outline may be cited.

As far back as 1680 to 1740 Jethro Tull, in Britain, laid down a principle that is the basis of scientific farming methods—in more or less dry regions particularly—to-day. The doctrine that he taught, in his crude way, was that thorough and proper tillage might take the place of manure, and the recognition to-day of the virtue of summer fallowing had its beginning in his time. The beneficial effect of fallowing land, this causing the formation and accumulation of available plant-food in the form of nitrates, and of systematic surface cultivation for the conservation of soil-moisture and the rendering available of soil-constituents, is now too well known to the up-to-date farmer to require further explanation here.

The important discoveries associated with the nutrition of plants, particularly as regards the assimilation of nitrogen, have been far-reaching. The researches of such scientists as Liebig, Lawes and Gilbert, Hellreigel and Wilfarth, and Beyerink on this latter question had a particularly important effect upon agricultural principles and methods of to-day. To Hellreigel and Wilfarth fell the honour of discovering the fact that legumes assimilate nitrogen from the soil-air by means of bacteria associated with the roots of leguminous plants.

To Beyerink fell the distinction of isolating the organism (*Pseudomonas radicicola*) responsible for such assimilation. This, the extracting and fixation of atmospheric nitrogen, has been described as the most far-reaching discovery of modern times. It indeed revolutionized the ideas previously held regarding soil-fertility, and laid the foundation for our modern ideas respecting farming practice. This scientific discovery alone has not only vastly increased agricultural production throughout the world, but it has pointed the way for the maintenance of soil-fertility by suitable crop-rotation embodying the periodic use of leguminous crops. The significance of this statement is grasped by the man on the land when he thinks, for instance, of the ever-growing importance of the clovers, lucerne, and peas, from among the great range of leguminous crops, in farming economy throughout the world. The productive powers of these crops alone and their soil-nitrogen-building value are of enormous benefit to any country where agriculture is an important industry.

The manufacture of superphosphate, as the result of the researches of those patient scientific workers, Lawes and Gilbert, whose names will ever remain on the honour roll of agricultural science, was a discovery that was destined to play an important part in the practice of modern agriculture. Superphosphate is perhaps the most used of any commercial fertilizer to-day; it usually constitutes the basis of manurial mixtures, and is the most soluble of all phosphates.

The manufacture of basic slag as a by-product of the steel-making industry, and the discovery of its manurial value for soils, can also be attributed to the indirect and direct work of science. Since this discovery there has arisen an enormous demand for basic slag, for application to clay and clay-loam soils more particularly, and for top-dressing pasture lands. So great became the demand for slag that previous to the war Germany was producing large quantities of artificial basic slag by mixing in finely ground form and in definite proportion rock phosphate, limestone, and cinder containing forms of iron oxide. Large quantities of it were being shipped to the British dominions, including Australasia. Some time ago the British Government placed an embargo on the export of basic slag, thus emphasizing its value to British agriculture, particularly in time of war.

To experimental science we are indebted for a large fund of knowledge of the correct use of manures with respect to varying soils, climates, and crops. Our knowledge of chemical analysis, by which soils, manures, plants, rocks, animals, liquids, and gases are separated into their component parts, is due to the patient work of science carried through many years of exacting laboratory research work. By the material aid of chemical analysis the farmer is enabled to

control the treatment of his soil, of his crops, of his live-stock, and the purchasing-power of his money in that respect. To experimental science also the man on the land is indebted for valuable information respecting that most important subject to New Zealand agriculture—limes and liming. The chemistry of limestone, the forms of lime of value to agriculture, and the fund of knowledge relative to the effects of limes, also as to how and when liming should be undertaken, are due to the work of experimental science more particularly.

One of the most potent discoveries connected with that important branch of agriculture, dairying, was the Babcock test. By its use the quality of milk can be readily ascertained, and this, when considered with quantity or yield, enables selection of high-producing dairy stock to be effected. The possibilities of such selection, if universally carried out, with respect to the increase of a country's dairy-products are enormous. Science has also in other ways contributed very materially to the advancement and perfection of the dairy industry.

As already indicated, the invention and perfecting of the refrigeration process is attributable to science—to knowledge of chemistry and physics, pure and applied, associated with ammonia more especially. To this distinguished contribution of science New Zealand can render homage, for to the invention of refrigerating machinery can be assigned the material prosperity of this country in recent years. Other countries producing perishable food products in huge quantities, of course, have vastly benefited, thus further revealing the far-reaching nature of this gift of science.

The economic feeding of live-stock, by which "balanced" rations are supplied so that the maximum results may be obtained at the least cost and with the greatest conservation of nutrients or food elements, is the result of most exhaustive and exacting scientific investigation. The work of certain scientists, notably Kellner, in this direction was of the first importance. It is shown, for example, that a definite weight of maize (rich in sugars and starches) and lucerne (rich in protein) mixed in the proportion of two of the former to one of the latter has greater productive value than a similar combined weight of these crops when fed separately to an animal. Likewise, other crops or fodders rich in protein can most profitably be balanced with crops or fodders in which starchy and sugary substances predominate.

The farming world can also thank science for the identification and classification of pests, both insect and fungus, that attack the crops; for the examination of their habits and characteristics; and for the discovery of remedies for their control in numerous instances.

Similarly, the bacterial and other diseases attacking live-stock are combated by the scientist with the material aid of the results of scientific discovery.

The breeding and selection of types of animals and plants that are of advanced productiveness, whereby the results accruing from the labour and husbandry of the farmer are greatly enhanced, is made possible as the result of scientific research. Many improved strains of farm animals, and numerous types of cereals, grasses, and fruits, have been and are being produced by scientific workers schooled in the laws associated with heredity and variation, this meaning improved agriculture and consequent increased material wealth.

Science has also made possible the study of the atmosphere and the consequent forecasting of weather conditions, thereby warning the farmer and avoiding considerable loss of wealth.

Vast improvements in agricultural machinery, and in the great realm of machinery generally that in any way deals with the products of the farm, have been effected by science and invention. Indeed, it has been said that farming to-day is in a large sense done in the foundry and workshop.

Science has, in general, made possible the systematic study of the various factors connected with farming, and as a result has indicated and is indicating directions along which economy and efficiency can be exercised, together with the means necessary for effecting such. Agriculture, it can be truly said, has been systematized by science, and "hit or miss" farming has thereby been greatly minimized. Many farming operations are to-day carried out according to established practices based on the results of careful scientific investigation. In a sense, definite formulæ are adhered to, and rule or order takes the place of haphazard methods. Then, apart from the actual reduction of agricultural operations to definite lines of practice, we have science evincing itself in the field of agricultural economics, the object of which is to ascertain and devise means by which the more commercial side of farming can be developed. In North America particularly this phase has assumed very wide proportions, economy being encouraged in connection with everything appertaining to agriculture, be it improved production, management, extension of agricultural knowledge, marketing and exchange, agricultural finance, co-operative purchasing, or other lines of effort making for the uplift of agriculture.

In the realm of agricultural engineering science has also played an important part. By its aid the farmer is enabled to have his land surveyed, systematically drained in accordance with levels taken by the aid of scientific instruments, and (in regions of low rainfall) systematically irrigated. In irrigation science has played a particu-

larly important part. It has not only devised satisfactory methods of adequately reticulating water over large areas of formerly dry land, without wastage of water and without waterlogging such land, but it has enabled the "duty" of water to be satisfactorily studied, and times, quantities, and methods of application of water to various crops for maximum results to be thereby established.

Not only can science play a very important part in the direction of greatly increased production from the land (and such is the country's one great hope in meeting the material cost of war), but it can at the same time work directly in the interests of maintaining soil-fertility, without which maintenance no country can possess a sure guarantee as to its national future. The facts of history contradict the belief that such fertility will endure without the most anxious and strenuous care. As we are reminded by the champions of the conservation of natural resources in North America, and by others, history reveals the fact that lack of scrupulous care regarding the maintenance of soil-fertility and continuance of occupation of territory by populous nations are not compatible. Moreover, the experience of our own times bears witness to the same fact. There have been thousands of farms in the New England district of the United States of America practically abandoned through depleted fertility of soil.

In New Zealand, particularly in certain parts, we have no reason to be proud of our treatment of the soil. Over a great portion of the country the fertility of our virgin soils is not what it originally was, and in many instances it has been very materially reduced by continuous cropping and other soil-depleting practices. In certain parts cereal crops have been grown almost continuously for twenty-five or thirty years. No thought of rotation of crops has ever been entertained, nor, at least, proper crop sequence ever attempted. Soil-depletion in these localities has gone on apace for many years, and yet we find settlers sometimes asking why it is that they are not getting the same yield of certain crops as they obtained in the early days. Nature is kind, but if her laws are disregarded she will not go on for ever giving. Mixed farming, embodying the keeping of live-stock, is, as a rule, the crying need of these isolated districts.

Despite the many wonderful achievements of science, there is yet very much for it to accomplish. To the student of this great subject (or group of subjects) there appear continually points upon which light is lacking or which are at least obscure. The field for further research is vast. This is particularly so with respect to certain phases of agricultural science, which form of science is so intimately associated with life of all kinds and closely concerned with the material welfare of the life of man. Agriculture indeed affords a boundless field for scientific investigation, and here in New Zealand we have merely

touched the fringe of the subject of higher agriculture. True it is that pioneers (all too few) have been busily engaged introducing this worthy subject into the various agricultural districts of the country; but what has been so far accomplished is merely a small fraction of the country's requirements in this respect, particularly at this time of national stress, when vastly increased production is required to feed the millions of those withdrawn from normal industry and engaged in connection with the war or in distress therefrom, and to meet the huge material cost of the struggle.

Apart from the need for scientific investigation in connection with the primary industries of the country, the necessity is great for systematically imparting knowledge of well-established fundamental principles associated with elementary agricultural science to settlers in our various farming districts. True it is that many of our farmers are well-read, enlightened men, but there are very many who by stress of circumstances have been unable to obtain a proper grasp of the fundamentals connected with their avocation. A majority systematically schooled in these principles would unquestionably greatly increase the agricultural output of this country. Research in connection with our agricultural industries is highly important, but the systematic teaching of fundamental principles to the man on the land is, in my opinion, of even greater importance.

The proven facts, associated with principles and practice, furnished to the mind of man by science, have enabled those trained in its teachings to persevere in the dissemination of such knowledge, despite obstacles of various kinds encountered on the march of progress and enlightenment. The true farmer presents as a rule an open mind to those endeavouring to advance agricultural production. He welcomes the impartial and earnest advice of the trained mind, for he is conscious of his great need for the assistance of science in the solution of the problems that are daily confronting him. Nevertheless, in many instances the man on the land is somewhat lacking in initiative, and demands exhaustive demonstration of truths of science. But, as time proceeds, initiative is acquired—through adequate instruction in and familiarity with the new methods.

In this article the writer has endeavoured to indicate to some extent how science has vastly aided the avocation of the farmer, and in some respects has been the resurrector of agriculture. The subject is, of course, too vast for justice to be done to it in a few pages, but if sufficient interest has been created to promote a thirst for more knowledge of agricultural science on the part of the man on the land this brief treatise will be of sufficient length. Science and its application particularly to the primary industries of New Zealand should be the future watchword of this country.

TWO NOTES ON LIMESTONE.

B. C. ASTON, F.I.C., Chemist to the Department.

FINENESS OF GRINDING.

A RECENT American publication (*The Canner*, 29/11/17) quotes some remarks of Dr. Cyril G. Hopkins, the well-known writer on soil science, on a subject which is frequently a cause of discussion—namely, the state of fineness to which limestone should be ground in order to produce the most profitable results. Dr. Hopkins's ideas are so closely in accord with what the present writer considers to be good agricultural practice for New Zealand conditions that he here quotes what was said by that authority, as follows :—

"Carbonate of lime does not need to be exceedingly finely ground, because limestone is quite readily soluble in salt water, and if too finely ground there is likely to be great loss by leaching. We do not know yet just the absolutely ideal conditions to which the limestone should be reduced, but I am frank to say that from all the information we have thus far secured I shall not be surprised if, when the data are all in and the final conclusions can be formed, we shall find that the most economical material is that which passes through a quarter-inch screen, including the total product, of course, which will vary from the finest dust up to pieces a quarter of an inch in diameter. Of course, when we make an application of limestone we are thinking of two very important effects. One is immediate results, and the fine material produces that. The other is durability of the effect, and the coarser particles produce that. If you should put the same amount of money into the product—the total product of ¼ in. in diameter and less that you would in order to get that product through a fifty-mesh screen—I should not be surprised if in the long-run you would be better off."

Of course, the price paid for a coarsely ground limestone such as this should be very much less than that paid for a finely ground product. Readers should consult the last October *Journal*, p. 190, for costs of crushing limestone, details of fineness, &c.

IS SOME CARBONATE OF LIME NITROGENOUS?

A much more weighty contribution to science comes from the Technological Institute of Kharkov, Russia. The reader must here be reminded that combined nitrogen, such as, for example, exists in

nitrate of soda ("Chile saltpetre"), sulphate of ammonia, calcium cyanamide, "nitrate of lime," dried blood, and bonedust, is the most expensive ingredient of manures. On the other hand, the uncombined nitrogen of the atmosphere is so abundant that this contains approximately four-fifths nitrogen to one-fifth oxygen. Hence it will be seen that, while combined nitrogen is extremely costly, uncombined nitrogen is of so little value that no price can be set upon it. The difference in the price of free nitrogen and of combined nitrogen is due to the great difficulty of making nitrogen combine with other elements. Chemists are therefore always on the lookout for some easy way out of the difficulty.

Lidov, a chemist who for the past fifteen years has been publishing researches on gases, has succeeded in making carbon combine with gaseous nitrogen at the ordinary temperature by the aid of finely divided iron, lead, and nickel catalysts.* At first the carbon unites with nitrogen to form active alpha-mono-cyanogen ($-C\equiv N$), and inactive beta-mono-cyanogen ($-N\equiv C$). At this stage the oxygen of the air takes no part, reaction being due to the nitrogen atom. The second stage consists of the addition of oxygen, forming respectively alpha oxan ($O-C\equiv N$) and beta oxan ($O-N\equiv C$). Under suitable circumstances peroxan (O_2CN) can also be formed. Lidov's experiments were conducted in sealed vessels, using as a source of nitrogen atmospheric air from which the carbon dioxide had been removed, and the reaction was spread over several months. He claims that his results account for the variation in the amount of nitrogen in the air at different times of the year.

Up till this stage the practical man might ask whether this research is going to lead to an economic result. The analogy between the oxans and carbon dioxide suggested a search for the former in nature. Lidov thereupon looked for these products of the laboratory in the atmosphere, natural waters, and mineral carbonates. He claims to have found varying amounts of active alpha-mono-cyanogen in the natural carbonates, and the statement is made that the calcites consist chiefly of calcium alpha-oxanate. Calcite (a pure form of "carbonate of lime") contains both calcium oxide (pure quicklime) and combined nitrogen, "and on this account ought to be very useful as a fertilizer."

Dr. C. Scott Garrett, to whose abstract of this research (in *Science Progress* for 1917, p. 25) the reviewer is indebted for the foregoing information, lays particular stress on the importance of Lidov's work,

* A catalyst is a substance which induces chemical reaction between two compounds with which it is in contact without itself changing in composition. The use of catalysts—frequently the oxide of some common metal—is of great importance in industrial chemistry, as reactions are by such means more easily induced and controlled.

which he describes as one of the most important advances which have been made in the domain of inorganic chemistry in recent years; but he explains the necessity for confirmation by other chemists—a statement that will meet with general acceptance.

PASPALUM IN AUSTRALIA.

J. R. MACDONALD, Sydney, N.S.W.

THE North of Auckland and the North Coast lands of New South Wales hold the greater areas of paspalum in Australasia, and an account of the behaviour of the grass in New South Wales will therefore be of interest to the North Auckland farmers and others concerned.

There is not a vital difference between the climates of Northern Auckland and the north coastal lands of New South Wales, in which latter paspalum is almost the sole grass of a great extent of country. The annual rainfalls of both are high, although the North Auckland precipitation is more evenly distributed throughout the year. The New South Wales experience in the north coast district is more one of heavy downpours — too heavy oftentimes — with longer dry spells in between. Both climates are influenced by coastal humidity, and this, with good rainfall, appears to be what paspalum revels in and what helps its growth for a lengthened period of the year, as against the poor headway it makes where early and late frosts are a feature. The experience in New South Wales is that when rain is continuously absent the grass dries up and presents an uninviting pasturage, and a general complaint against paspalum is that it takes a rather long time to make fresh growth after rain.

Some dairy-farmers would like to see paspalum disappear, but it is generally accepted for its greater or lesser worth, and in favourable seasons provides a wonderful growth of valuable milking-grass. At any rate, since its introduction to the north coast of New South Wales dairying has made great strides, and that part of the State is now studded with butter-factories and prosperous towns.

Paspalum, unless the writer is mistaken, was introduced to New Zealand from New South Wales, and it is only twenty-five years since it was brought to the latter State from South America, where it plays an important part in pastoral production. The grass at once set about proving that the acclimatization was all it desired, for it took vigorous possession of the land sown to it, and set about invading the whole countryside in the coastal region, where alluvial and basaltic soils are frequent, and where the rainfall is twice as great as it is in the other

parts of the State and three times as great as it is in the interior. It continues yearly to extend its domain, and is now to be seen in southern New South Wales and on the slopes of the cooler tablelands of the State, where climate is, however, less friendly to its advance. Cooler air and smaller rainfall provides less encouragement than coastal humidity and drip. Patches of it are observed around Sydney, growing vigorously in a damp season, but unable to make permanent headway against the ubiquitous couch.

A wet season is particularly favourable to the plant. The growth is profuse, and quickly outreaches the consumption of average stocking. With conditions favourable, the way in which it supersedes all other grasses is notable as giving no encouragement in efforts at its repression. Hardly anything in the whole catalogue of pasture plants is able to stand up to it (it will even compete with buffalo-grass) under favouring conditions, which are mild semi-tropical climate and ample rainfall. The banana ripens well in much of the country under paspalum in the New South Wales north coast. General cultivation would be the only hope of checking the paspalum, but such practice goes along with close settlement, a thing as yet of more or less nominal consideration in the wide areas and sparse population of Australia.

Apart from buffalo-grass, clover appears to be the only other plant that can successfully grow in paspalum pastures, and where clover is present it adds greatly to the value of paspalum. The combination of white clover and paspalum provides a rich and balanced milking-food quite free from the taints of weeds that are so often common in other pastures.

When satisfactory damp summers on the coast of New South Wales occur the dairy-farmer has an abundance of paspalum feed, but a severe or long winter, when there is no growth in the grass, sees the farmer looking around for other foods to keep his stock going. Some few farmers make hay of the overplus summer growth, but not many. Others plough up a paspalum paddock—for all the farm is paspalum—and sow it down with maize or in other grasses to provide for the winter deficiency. In doing this the farmer has two objects in view, and he does not expect to displace the paspalum. He seeks to obtain a temporary change crop and at the same time to rejuvenate the lessening ability of the paspalum to grow feed, for old pastures of paspalum become a mass of strong roots, matted to such an extent as to preclude even the entry of rain to the soil. This is the substantial objection to the grass, and in some parts the pasture, on account of the choking root-system of the grass, provides in the course of about ten years' time little or no feed.

To break up the paspalum land is no easy task. There is such a strong, coarse root-system that ploughing and cross-ploughing have to be resorted to to tear asunder the roots and permit of the use of

the harrows. A disk plough is used. In some parts so tenacious are the roots that a specially made plough, drawn by bullocks, is used. The land then is sown with maize, or rye-grass, cocksfoot, and the like, followed by a green winter crop. The paddock afterwards is allowed to revert to paspalum, which quickly takes possession once more, with a maiden growth giving greatly improved feed for dairying-stock.

MEALY BUG ON VINES.

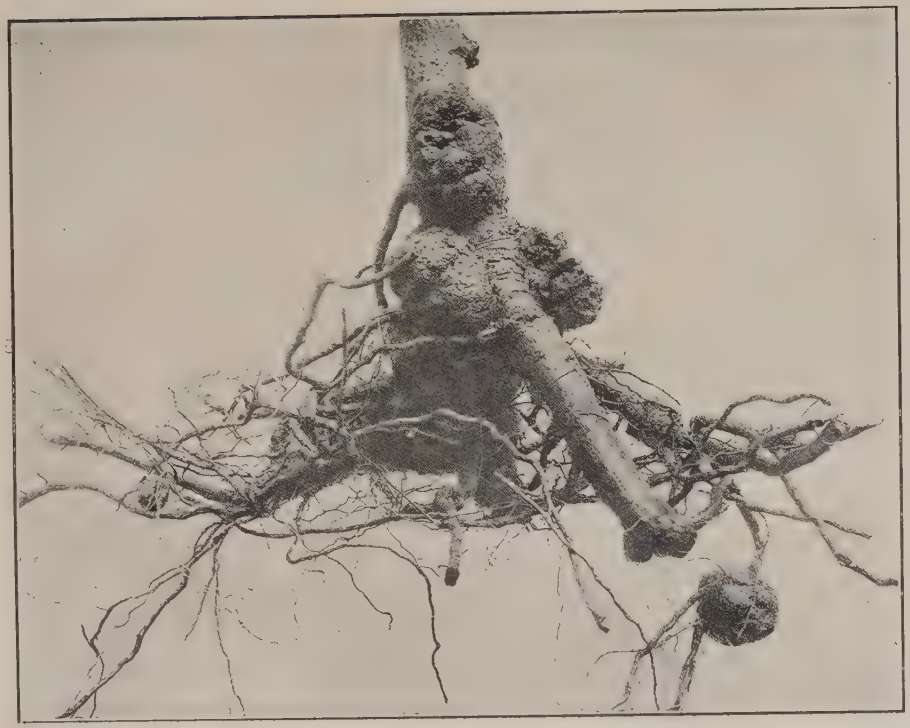
NICOTINE FUMIGATION UNSUCCESSFUL.

THOSE who are so unfortunate as to have grape-vines infested—though ever so little—with this filth-producing insect should make an attempt to destroy it before the leaves fall. Even with grapes hanging it is possible to do much to lessen its numbers. There may be exceptional cases, but no one can be certain that even slightly bug-infested vines will not reach a condition when the pest becomes a serious trouble.

In a recent number of *The Garden* (15th September, 1917, p. 384) an article by R. P. Brotherson treats very fully of the control of mealy bug. In this article it is very confidently stated that mealy bug (not the eggs) can be killed by fumigating with nicotine compound by doubling the quantity given in the general directions. It is further claimed that this specific can be used at any stage of growth without injury to the foliage and fruit.

With a view of thoroughly testing these claims for the benefit of New Zealand vine-growers a vinehouse badly infested with mealy bug was selected and an exhaustive experiment made recently. Although an old building, the house was made fairly tight. The fruit had been thinned and there was not an overabundance of foliage. It contained 2,880 cubic feet of space. On the evening of the 13th December, using two fumigators, sufficient XL-All poisonous nicotine for 5,000 cubic feet was evaporated, a generous quantity being allowed so as to give the compound every chance. The following day many live mealy bugs were found in the house, and were alive in a box seven days after. It was suggested, as an extra test, that two further fumigations be given, one following the other. This was done on the 18th and 19th December, using the same quantity of the fumigant each evening—namely, sufficient for 5,000 cubic feet. The result was not any better, many bugs being found alive.

The treatment of mealy bug on vines is fully gone into in the Department's Bulletin No. 40, "Cultivation of the Vine under Glass," and up to the present no more effectual methods have been proved here. The experiment recorded should save growers expense and disappointment in attempting the control of this troublesome pest by other means.—*S. F. Anderson, Vine and Wine Instructor.*



ROOT-KNOT.

THE accompanying illustration is a photograph of the roots of a peach-tree imported from Australia in 1915 and dug up in 1917. A small consignment of peach-trees received in the former year showed indications of root-knot, and the trees were therefore planted apart in order to test the matter. In two seasons they developed knots and galls as shown on the specimen photographed. —*T. W. Kirk, Director, Horticulture Division.*

[The subject of root-knot and the related prohibition of the importation of fruit-trees from Australia was dealt with in the *Journal* for August last.]

WORK FOR THE COMING MONTH.

THE ORCHARD.

J. A. CAMPBELL, Assistant Director, Horticulture Division.

REVIEWING THE SEASON.

APART from picking, marketing, and storing the later varieties of pip-fruits the coming month is a comparatively quiet one in the orchard. Other than in exceptional cases the end of March sees the close of the spraying season.

Practically every orchardist is now in a position to review the season and to form a fairly definite idea of how it has treated him. In doing so, if he is a wise man, he will also go very carefully into the question of how he has treated himself, for in very few industries does the "man behind the gun" play a more important part in aiding success than in the fruit industry.

Fruitgrowing is beset by a large range of injurious insects. Variations of climatic conditions have to be met, ranging from excessive wet and stormy weather to droughts of more or less severity. Whether the season be one or the other or a mixture of both, whether the diseases be few or many, whether they be those that flourish under semi-tropical conditions or those that prefer the reverse, the intelligence of the orchardist must be sufficiently versatile to carry his crop through successfully. That this can be done has been amply demonstrated in the past. Such demonstration, however, has never been the result of half-measures. What may be termed excessive measures have also failed owing to the work not having been intelligently attended to during certain critical periods. In short, the great requirement in the control of orchard diseases is to do the right thing at the right time according to the conditions prevailing, and, above all, to do it well.

Now is the time for the orchardist to thoroughly investigate the spraying methods practised by him during the season. Every grower should keep an orchard diary in which to record all matters of interest that may come under his notice, paying particular attention to recording all spraying formulæ, strengths, dates of application, related climatic conditions, results, &c. All up-to-date growers do so, and by this means add to their knowledge year by year.

Should the season's work be successful it is not sufficient to merely record this with a view to adopting similar methods next year; the matter should be investigated with the object of definitely determining the factors that contributed to such success, as incorrect deductions are very apt to lead to more or less disastrous results when conditions are reversed. On the other hand, if the season's work has been unsatisfactory and the percentage of disease high, careful investigation is more urgently necessary. Such results prove beyond doubt that something is radically wrong with the methods employed. Either one or the other

of the spraying formulæ was inferior, or the manner and time at which they were applied was at fault. If the standard sprays were used and the orchard was otherwise in a satisfactory condition the grower may in nine cases out of ten rely upon the trouble being due in some way or other to his methods of application.

In support of this I may refer to a case that came under my notice this season. An orchardist owning several acres of large pear-trees was particularly anxious to combat black-spot. The orchard is situated in a locality in which black-spot has been troublesome in the past, and particularly so during the last three years, owing to the excessively wet seasons. So badly was fruit affected, despite spraying, that many growers had lost faith in this means of controlling the disease, and as a result were agitating for the removal of the restrictions on the sale of fruit affected with black-spot. The orchardist in question wrote to this office for full particulars of spraying for black-spot. These were forwarded, and were subsequently intelligently applied, with the result that he harvested in a district where black-spot still abounds a 98-per-cent. clean crop of as fine pears as one would wish to see. This goes to show that methods are as important as mixtures in controlling orchard diseases. Particulars of the case referred to will be given in next issue of the *Journal*.

BROWN-ROT.

The preceding remarks regarding the control of diseases generally do not altogether apply to brown-rot. A considerable amount of information on the control of brown-rot has been gathered from the experiments carried out, but, unfortunately, we are not yet in a position to recommend a definite course of treatment that can be relied upon to control the disease under adverse conditious. Another season of experimental work will at least be necessary to confirm or otherwise any theories that have been arrived at.

In this connection it is not only intended to repeat the experiments of this season, but to extend them to other districts. Brown-rot is without doubt a pernicious disease, and one that is causing a heavy loss to stone-fruit growers, and the development of a reliable control is essential. With the object of devising such a remedy the Department will continue experimenting at the Arataki Horticultural Station, and is also prepared to co-operate with fruitgrowers' associations in conducting experimental work, and to pay the cost of all such experiments that may be arranged.

HARVESTING AND STORING THE FRUIT CROP.

This is really the work of the orchard at the present time, and it is, of course, one of great importance. How and when to pick, how to handle, pack, and market, are matters that concern every fruitgrower. As far as packing, marketing, &c., are concerned, those fruitgrowers who have co-operative companies or other packing-houses working in the vicinity are very much better off than those who have not, but even where such facilities exist the importance of proper picking and handling still apply. No packing-house can hope to turn out a high-class reliable pack unless it is supplied with good-quality fruit free of all bruises, blemishes, stem-punctures, &c.

The nature of the market and the hanging-quality of the particular variety to a great extent governs the state of maturity at which fruit should be picked.

Apples for storage or export should not be allowed to hang after they reach maturity; those for the local markets are better left for some time longer. The darkening of the pips is the common guide to picking, but this is not altogether reliable, as the pips often turn colour while the fruit is still too immature for picking. Still, the colouring of the pips, together with the general appearance of the fruit, forms a sufficient guide for a person experienced in the work.

All the fruit should not be removed from the tree at once. The tree should be gone over two or three times, and the most advanced fruit gathered on each occasion. Fruit should not be forcibly removed from the tree. If this is necessary it can generally be taken as an indication of immaturity. When picking all fruit-buds and spurs should be protected, and stems retained in the fruit. The latter is very important, particularly with fruit which has to be stored or shipped.

Fruit should be handled very carefully both when picking and on the road to the packing-house. To prevent bruising, the picking-box should be well padded and the orchard-cases not too deep. If fruit is to be landed at the packing-house in a satisfactory condition, the fruit-wagon should be well sprung, loaded to suit the springs, and carefully driven to the packing-house.

In this particular, at least, orchard packing has an advantage over central packing. The fruit in this case is packed in a shed close by, and there is less danger of deterioration through rough handling. Orchard packing, however, has many disadvantages, and must give way to central packing. But before the latter can be made a success the fruit must be landed on the premises practically as good as when it comes off the tree.

POULTRY-KEEPING.

F. C. BROWN, Chief Poultry Instructor.

THE BREEDING MALE.

THIS side of the mating preparations should now receive careful attention. In selecting a male for breeding purposes, with a view to promoting egg-production, the strain from which the birds are bred is of the greatest importance. In the first place, it is essential that the stock be purebred, for it is only by breeding from purebred stock on both sides that desirable characters can be perpetuated with any degree of certainty. This has been proved over and over again. Any bird which does not come near to the standard requirements of the breed it represents should be rejected.

Having purebred birds to select from, the next important consideration is that of points indicative of a strong constitution. A bird may be of ever so good a breed type and the son of a heavy-laying mother, but if he shows any signs of having a weak constitution his pullets will

prove disappointing. It stands to reason that for a hen to produce 2 oz. eggs day after day, and at the same time have the power to resist disease, she must necessarily be endowed with exceptional constitutional vigour.

The chief points indicating stamina are a bold, prominent eye—as fiery as possible; a clean, well-coloured face; a short well-curved beak; a broad but neat head; tight feathering; full crop; and short shanks set well apart, which give the body a well-balanced and active carriage. Never breed from a male with knock-knees, long shanks, a spare crop, or one having feminine characters, as these indicate lack of vigour, and are usually followed by a full measure of disappointments. The ideal breeding male should be in every respect masculine, and, while having the necessary weight, should possess a certain amount of refinement, of which a fine texture of comb and a silky feather are desirable. It should never be forgotton that the male is more than half the breeding-pen. Not only should he be of undoubted stamina and utility quality, but he should have every opportunity for developing naturally and maintaining himself in the best health possible.

Never put a growing cockerel intended for the breeding-pen under what might be termed hothouse conditions. He should be given a good range, and, if possible, kept out of sight of the opposite sex.

Another fault in developing the breeding-cockerel is in overfareing it with stimulating foods. The effect of too much rich diet is to bring a bird too early to maturity, with the result that it never attains the desired size. Never, under any circumstances, select a male that matures too early. Usually such a bird is more fascinating to the eye than one of the same age in the flock which looks juvenile. For instance, in the former case a bird may exhibit most of the characters looked for in a desirable male, such as good symmetry and an alert, active appearance. In other words, he may be a well-matured, pretty little bird for his age. Where the chief weakness lies in choosing such a specimen is that he remains a pretty little bird, and the lack of the necessary "timber" makes him useless for breeding purposes.

There is a general tendency at the present time for many of our useful breeds of poultry to become far too weedy and much below standard weight requirements, and it is not the diminutive male which will tend to correct matters in this respect. The safest policy is to choose a slow-maturing bird, providing, of course, he exhibits a good frame and is active. It is usually the case that the slow-maturing, big-framed bird is the last to shoot his comb, and generally to show his male characters.

When selecting a male or a female for the breeding-pen aim at an ideal type, and, while keeping this always in view, remember at the same time that constitution must never be lost sight of.

MANAGEMENT OF THE BREEDING-HENS.

In my last month's notes advice was given in regard to the selection of the most desirable hens for next season's breeding-pens. It was pointed out that the best birds for this purpose are the late moulters, of good size, and which possess the maximum amount of points indicative of constitution and laying-power.

As soon as the best specimens are chosen on these lines they should be specially marked, placed by themselves, and an endeavour made to retard egg-production. In fact, it is a good plan to force the birds into a moult, by means of suddenly changing the food or quarters. Then, when the moulting process commences, they should be liberally fed on a plain nutritious diet, so that they may have an opportunity of recuperating and building up their stamina before being called upon to produce eggs for reproductive purposes. It is always a mistake to force every egg out of a bird it is intended to breed from. Of course, in the case of the laying-flock the objective should be to keep the birds steadily laying, and to secure the most eggs in the shortest space of time. Especially does this apply with birds coming to the end of their second laying season, and which it is intended to cull out at its termination.

LEG-WEAKNESS.

A common trouble at this season of the year is leg-weakness and apparent paralysis of the legs in half-grown cockerels. There is a common but mistaken impression that this trouble is solely due to the birds being hatched with a weak constitution. Leg-weakness may certainly be sometimes due to an hereditary general weakness, but usually it is the result of overfeeding forcing-foods, such as meat or its substitutes, and keeping the birds in confined, stuffy quarters. Far too often after the most desirable cockerels are selected for breeding purposes they are placed in a small coop, without any of the requirements which tend to promote good health. A growing cockerel may be ever so healthy and possess ever such a strong constitution, but if subjected to such treatment it stands to reason that the bird's vigour must become impaired. In the case of breeds with large combs, such as Leghorns, Minorcas, &c., leg-weakness is usually accompanied by a falling-over of the comb. Confinement with insufficient room to exercise and an oversupply of rich food cause extreme development of the comb, and a consequent falling-over of this ornamental feature by reason of its extreme weight.

Confined quarters and forcing-foods are necessary when priming cockerels for table purposes, but they are most undesirable for vigorous and healthy growth, having a tendency to overforce the birds and bring on leg-weakness and other troubles. No cockerel that has been affected with leg-weakness should be used as a breeder, as it indicates an hereditary weakness, or that the constitution has been weakened through improper management. Once a bird becomes affected in this way it is useless trying to doctor it. As with most other troubles affecting poultry, prevention is the one thing to aim at. The essentials for this purpose are breeding from only healthy parents, giving the young ones an ample supply of plain but nourishing food, and a liberal range under the most natural conditions possible. Good breeding and good management must go hand-in-hand.

WORMS.

I visited a small plant a few weeks ago to give advice as to why the twenty-five hens in stock were not laying more than six eggs a day. I was assured that they were given as much food as they could eat, were well housed, and had a good run. After examination of the flock the cause of the poor laying was apparent. The birds showed strong

evidence of being affected with intestinal worms. The combs were more or less black, the feathers loose and ruffled, and generally the birds were in poor condition. Another sign indicating that worms were present was that the birds were continually stretching their necks and making a screeching noise as if suffering from croup or other throat trouble. Acting on my advice, the owner starved the flock for a day, and then gave them a dose of Epsom salts, about a 1 oz. packet for every twelve birds, dissolved in the water with which the mash was mixed, adding also to the mash some sulphur in about the same amount as the salts, which was well mixed with the ingredients of the mash before being moistened. The effect of this treatment after a fast, which was repeated three times during a fortnight, was to expel the worms. The owner now advises me that he is getting from sixteen to eighteen eggs a day, and that the entire flock is in the pink of condition. It is feared that this is only one of the many cases that could be cited in which the low egg-yield is entirely due to intestinal parasites.

THE APIARY.

E. A. EARP, Apiary Instructor.

REMOVAL OF SUPERS.

AMONG the autumn work which must not be neglected is the removal of the supers, and this should be undertaken as soon as the extracting-combs are cleaned up by the bees. It is bad management to leave the bees more space than they can occupy. By removing the supers the space in the hive is restricted, and consequently it is much easier to make the bees snug and warm for winter. Where the strength of the colony will permit this to be done nothing is to be ganied by leaving on the supers. However, it may be impossible in the case of strong colonies to confine the bees to the brood-chambers, in which case the supers can be left on the hives until the spring. By that time most of the bees will be in one story, and the supers can then be removed.

A good plan to follow in getting the bees to clean up the combs is to insert a mat, in which a small hole has been cut, between the brood-chamber and the super. The bees, finding the combs partly cut off by the mat, lose little time in removing the surplus honey. At this operation the excluders should be removed from the hives and stored away until such time as they can be cleansed of burr combs. A little care is necessary in dealing with the excluders, so as not to bend the wires. They can be readily cleansed by plunging into boiling water.

WINTER STORES.

The losses attendant upon starvation are no less serious a menace to the beekeeper than disease. While disease is met with from time to time, each autumn brings the problem of wintering the bees. It has to be faced every winter, and, while the professional will prepare his

colonies so as to guard against serious losses, the average beekeeper is apt to overlook the essentials that make for success. There are factors such as shelter, watertight hives, vigorous young queens, &c., which all play a part in the wintering problem; but, above all, a supply of food sufficient to meet the colonies' wants must not be overlooked. The safe wintering of bees is a test of a beekeeper's capabilities, as he is called upon to gauge the amount of stores required to tide his bees over the period between the autumn flow and the appearance of the early nectar-secreting plants. Locality plays an important part, more especially where autumn flows are unknown and fine autumn weather prevails. In these districts the consumption of stores is greater, and a constant watch must be kept on the hives so as to determine the amount of food required to guard against loss, as breeding will be carried on until a later period in the season.

Various estimates have been given as to the amount of food required to winter the cluster—varying from 30 lb. to 40 lb.—and experience has proved that, providing a colony is left with this amount, it will not only winter well but will build up rapidly in the spring. In any case, it is by far the safest policy to leave an excess of food rather than run the risk of leaving the colony short and with barely enough to tide it over the dormant period. Where the amount of stores is less than 30 lb. the shortage can be made up quickly by the insertion of a few combs of honey. Calculating on the basis that a full comb contains 6 lb. of honey, it is easy to estimate the weight of honey in the hive. If, however, combs of honey are not available feeding should be undertaken. This latter operation should not be delayed till the cold weather, but commenced early in the autumn.

For supplementing the stores sugar syrup, fed in the proportion of wo of sugar to one of water, is the best substitute for honey. Avoid using inferior qualities of sugar. None but the best white sugar should be fed. In feeding to augment the winter food-supply it is often necessary to feed large quantities of syrup, and consequently large feeders must be adopted. The Miller and the division-board feeders are excellent for the purpose. The former enables about 10 lb. to 25 lb. of stores to be fed at one time. It is designed to be placed inside the super or upper story on top of the brood-frames, and has two compartments for syrup, the passage-way for the bees being in the centre through the bottom, directly over the cluster. The division-board feeder is popular, and enables about 5 pints of syrup to be fed. Hanging between the frames, all that is necessary is to turn back the mat so that the opening in the top is exposed. The main advantage of this feeder is that food can be supplied without exposing the cluster and without the aid of smoke.

SHELTER.

As in the spring, a vital necessity at this time of the year is shelter for the hives. Brood-rearing must be encouraged if the bees are to go into winter quarters sufficiently strong to give good results the following season. If a shelter hedge or fence has not been provided an excellent temporary breakwind of manuka scrub can be erected. Shelter without too much shade is the life of an apiary, and on no account should large trees be utilized as a means for protecting the hives. The spaces between

the trunks are productive of draughts, and the high branches exclude too much of the sunlight. A line hedge 8 ft. to 10 ft. high is the ideal shelter for an apiary.

FOUL-BROOD.

As advised last month, every effort should be made to winter only clean colonies. The risk attendant on carrying over diseased bees is too great, as the trouble is more likely to be spread in the autumn and spring by robbing. In cases where weather conditions have prevented successful treatment, or in which disease is detected on making a final examination prior to putting the bees into winter quarters, it is advisable to remove all combs showing the slightest signs of disease. Where disease is detected in a bad form nothing will be gained by holding the colony over for treatment, and it is by far the safer plan to destroy. In mild cases remove all the diseased combs and substitute clean drawn-out extracting-combs, and, provided plenty of capped stores are given, this will tide the colonies over until the spring. Mark all infected colonies as a reminder for early treatment. Avoid disturbing diseased hives in the off-season, and guard against manipulations calculated to disturb the bees and induce robbing.

BOTTOM-BOARDS.

Among the work requiring attention in the autumn is the cleansing of the bottom-boards. This operation can be undertaken before finally closing down the hives for winter. Usually there is an accumulation of pollen, wax particles, and dead bees, and, if left, this material is likely to become mouldy and offensive to the bees. All operations should be carried out as quickly as the work will permit. A good plan is to provide a spare bottom-board. Lift the hive on to the spare one, scrape the old board, and replace the hive.

SPARE COMBS.

It is a frequent statement and a true one that next to his bees a bee-keeper's most valuable asset is his drawn-out combs. Complete combs of worker cells are absolutely necessary to the proper working of an apiary, and merit careful treatment at the hands of their owner during the off-season. They should be stacked in the supers inside a mouse-proof structure, and to still further guard against the attacks of mice each stack of supers should be covered with a queen-excluder. A few moth-balls scattered among them will prevent the attacks of the smaller wax-moth (*Achroea grissella*). Where accommodation cannot be found for the combs indoors they may be left in the hives over a mat placed between them and the brood-chamber, but in this latter case they must be weighted to prevent the winter gales from dislodging them.

ROBBING.

Where the extracting has been completed in good time and every care taken to remove temptation from the bees' path there should be little or no danger from robbing. However, where the honey has been left in the hives till late in the season the act of opening the hives and removing the full combs is apt to arouse the bees' predatory instinct. On no account leave combs exposed one moment longer than necessary,

either before or after extracting; carefully wipe any honey which may be spilled on wheelbarrow or other utensil in use at extracting-time, and see that every means of ingress into the disturbed hives is closed as soon as every manipulation is completed. Be sure the roofs are put on securely and that no robbers can crawl under them.

If robbing should take place in spite of all precautions, the apiarist should realize that he must take means to eradicate the trouble at once if he does not wish it to spread right through the apiary. He must realize that autumn robbing is very serious, and may tend to materially deplete his stocks before the bees settle down for the winter. The veriest tyro, by a little study of the entrance of a hive, can soon decide whether the colony is being robbed or not. Sometimes the young bees in their play-spell during the warm hours of midday may, at a casual glance, resemble a robber horde, but on closer examination the beekeeper will see that in such a case there is no struggle and consequent slaughter taking place at the hive-entrance. Moreover, there will be a steady stream of workers in and out of the hive intent on gathering the last of the failing honey-flow. Perhaps the surest indication of the well-being of a colony is the stream of pollen-bearers which every hive should have while the flowers last. If the apiarist sees the bees carrying in pollen without interruption he may conclude, whatever the excitement at the entrance, that the colony is not the victim of a hostile attack.

When robbing takes place in earnest perhaps the first indication the apiarist gets is in the noise the bees make. No other sound in an apiary is like it. It gradually develops into a steady purposeful roar, loud and aggressive, and in a short time the unfortunate colony will be assailed by a cloud of bees flying steadily at the hive, fighting with the inmates and with each other, and strewing the ground with the dead and dying. The beekeeper should at once contract the entrance of the hive until only two bees can escape at once. He should then pile wet grass high over the alighting-board, completely covering the entrance, and the grass must be kept wet. The bees outside will not force their way through the wet grass, and by the time those inside escape they will be glad enough to get out and stay out.

If bees persistently hang round a hive it is well to examine it as quickly and thoroughly as possible. Bees seem to have some uncanny instinct which tells them when a hive is weak or queenless, and if they persistently hover round one particular colony it is usually a warning to a beekeeper that all is not well therein. On examination the colony will usually prove to warrant removal by being united with one stronger and better able to guard itself. If a colony of this kind has to be opened, any frames which are removed must be kept covered with the carbolized cloths mentioned as useful at extracting-time.

One other matter to which the beekeeper should give his attention when the bees are inclined to rob is the protection of his honey-house. The windows should be provided with bee-escapes, so that all intruders may easily be removed, but on no account must there be any holes through which they can re-enter. Bees robbing a hive are bad enough for any beekeeper, but bees robbing a honey-house are like all the wild animals in a menagerie let loose, and the beekeeper who once allows this state of things to happen will usually reap his reward in the shape of innumerable stings from his infuriated subjects.

VITICULTURE.

S. F. ANDERSON, Vine and Wine Instructor.

THE VINEHOUSE.

ONLY the late grapes will now be left in the vinehouse. In the event of Gros Colman, Lady Downes, Gros Maroc, and Alicante not being fully coloured at the beginning of the month it will be necessary to keep up the temperature as far as possible by proper and close attention to the ventilation, and admitting more sun into the house by pushing the foliage on one side. This must be done, however, without exposing fruit that has been grown in the shade to the direct rays of the sun, as that may cause scalding. But no amount of sun at the fall of the year will colour the fruit of a vine that has been overcropped and insufficiently thinned. Look out for decayed berries and cut them out, as they cause others to go bad.

The importance of allowing unrestricted growth after the fruit has been gathered was pointed out in the viticulture notes in the December *Journal*. This growth will go on till the latter end of May, and will be strongest at the top of the house. To assist this the vine-borders should be kept clear of weeds by hoeing from time to time. After all the fruit has been gathered throw the house right open, so that the wood can fully ripen.

CELLAR WORK.

The control of the temperature in the vats at fermentation is very important, and should be watched carefully by the winemaker. There is always danger to the wine when the temperature is allowed to go too high, and the higher the saccharine in the grapes the greater the danger. The most suitable temperature for fermenting wine lies between 70° and 90° F.; at 95° it is unsafe. The reason is that the best forms of those micro-organisms that convert the grape into carbonic-acid gas and alcohol work well within the lower temperatures. Above 90° the condition becomes favourable to the injurious acetic and lactic ferments. The fermentation takes longer at the lower temperature. Frequent use should be made of the thermometer by plunging it into different parts of the vat at the critical period. If the temperature is found to be going over 80° draw off some of the must and pump it over the top. It happens sometimes that quite hot days and close nights occur during vintage-time, and it is just then that watching the fermentation is most urgent. The neglect of these precautions has resulted in some of the New Zealand wines being acetic—vinegary. There is a wide difference in a wine being high in tartaric acid and high in acetic acid. In the first case it is the grapes not being quite ripe enough, a condition which cannot always be avoided; but in the latter it can be avoided, and is the result of faulty and perhaps dirty methods in making the wine. For a vat of 400 to 500 gallons drawing the must off into a tub and pumping over the top for half an hour twice or thrice through the day should be sufficient to control the temperature and assist to increase the colour.

THE GARDEN.

W. H. TAYLOR, Horticulturist.

VEGETABLE-CULTURE.—CURRENT WORK.

TURNIPS for winter use should be sown at once in most places, but a month or more later will be soon enough in northern districts. It is a good plan to sow two kinds—a white, such as Snowball, for first use, and a yellow-fleshed variety for late use. The latter should be thinly sown, and thinned early to about 4 in. apart. For the white variety I recommend the market-garden plan—namely, to sow in rather broad drills so that the turnips do not stand in single file, thinning being confined to pulling some out where extra thick, and the rest done by pulling for use as they become fit. The produce of such a bed is many times greater than if thinned to single file, as usually advised.

The spring and early summer supply of cauliflowers is obtained by sowing seed during the last week in March or the first week in April. For first use sow Early Snowball or Early London. It is important that the plants be kept growing, as they are likely to bolt to head prematurely if subjected to any check. Where frost is severe the protection of a frame is necessary. It is better to sow in the soil than in boxes. The frames should be shallow, and lights should be taken off whenever weather allows. For later use sow Autumn Giant or one of that type, which are not prone to premature heading.

Cabbages should be sown at the same time as cauliflowers. Flower of the Spring, Sutton's April, and Early Etampes are the leading earlies at present, while Early Jersey Wakefield and Winnigstadt are also good. For later use sow one of the Enfield Market type.

Autumn is the proper time to sow the giant kinds of onion, of which Ailsa Craig is at present the best. Sow in a temporary bed for transplanting in spring. In places where onion-mildew is troublesome sow also a keeping variety of Brown Spanish type. Bulbs from this sowing mature early, and usually escape mildew. It should be understood that they do not keep as long as spring-sown bulbs, but they grow to a larger size.

Spinach for winter use should be thinned to not less than 8 in. apart. If the plants are not growing freely give a top-dressing of nitrate of soda, 1 oz. per square yard. A like dressing of nitrate of soda will assist the heading of cauliflowers now coming in, also the growth of broccoli, brussels sprouts, and cabbages. It will be particularly beneficial to any that were planted late.

PREPARING THE SOIL.

The breaking-up of new land should be done while the soil is moist; it is easy to work in that condition, and can be more thoroughly broken up. Autumn is the best time, as the soil will then be brought to a better condition to pass through winter, and will have time to settle before being put to use in spring.

Drainage should also be attended to at this season. Though soil that is waterlogged during the winter months may produce a summer

crop, it is rarely possible to avoid a late start. The soil in a garden should be in fit state for use all the year round. Soil that contains too much water is termed "sour," while that which is hard and impermeable is said to be "inert." Fertility in soil depends on the activity of certain microbes. The life of microbes depends on the presence of air, a certain degree of warmth, darkness, and an amount of moisture. Lacking these, soil cannot be fertile. When soil is waterlogged during winter it becomes very sour and cold. In spring a lessened rainfall may allow the surplus water to slowly drain away, but much of it escapes through the surface by evaporation. The result of evaporation is a lowering of the temperature at the place of evaporation, this lowering being in proportion to the heat of the sun. The hotter the sun the more sudden is the evaporation and the lower the temperature, the latter frequently being near freezing-point. Soil in that condition is not fit for use till late in spring.

When surplus water is drained away there remains only the amount that the soil can hold in suspension. This varies to some extent according to the class of soil; puggy clay and soil containing an excess of humus hold most moisture, and sand least. Clay is adhesive because of the exceeding fineness of its particles. Quicklime mixed with clay breaks it up, separates and surrounds the particles, and keeps them apart, thus making it more porous and admitting air, which warms the soil, increases the activity of soil-microbes, and so imparts fertility. Clay land that is wet in winter, and parts with its surplus water largely by evaporation, is very dry and hard in summer; it shrinks in bulk, and cracks. Drainage and lime will correct this. Clay soil that is not waterlogged in winter to any extent is similarly affected in summer and requires treating in the same manner. Drains increase the supply of air, and lime renders it porous.

Boggy land usually contains too much humus. Here also drainage will carry away surplus water, and render the soil pervious to air. Quicklime will act upon the humus, which will slake it; and the lime will absorb some of the moisture, making the soil warmer. Being a strong caustic alkali, lime will act chemically on the vegetable matter, combining with part of it, burning up another part, and laying it open to the oxidizing action of those microbes whose life-work it is in the presence of lime or other alkali to consume organic matter, converting its carbon into carbonic acid and its nitrogen into nitric acid, both of which combine with lime, and thus furnish a valuable contribution to the fertility of the soil.

Vegetable refuse, such as weeds, &c., which is incidental to every garden, is rendered valuable by making a heap of the stuff, and sprinkling a little quicklime as each layer is added. An objection to this method is that the lime generates ammonia, which escapes, carrying away nitrogen; but this can be prevented by covering the heap with a layer of soil. When rotted down there will be valuable material for digging in. Lime sprinkled on vegetable debris also prevents the growth of injurious fungi which cause losses in the vegetable-garden.

As quicklime burns a proportion of the humus in soil, it would not be right to dig it in to land deficient in humus, except in the case of clay land. My own opinion is that special liming is rarely necessary in a well-cared-for garden. I have not seen a garden that had not its share

of slugs, snails, &c. The only effective way I know of dealing with these pests is by scattering lime among the crops in the evening or early morning while the pests are active. The lime used should be air-slaked quicklime. Moisture on plants and soil further slakes the lime, and the action of air converts it again into carbonate of lime. In that form it will not burn humus, and is fit for digging in. If this is consistently done it will give the soil sufficient lime, and I am satisfied will do much to avert attacks from fungoid blights.

A WARNING REGARDING SHEEP-DIP.

A PREPARATION termed the "Anconia" sheep-dip has been lately placed upon the market in the Dominion, the manufacturers being stated to be an Auckland firm. The information acquired regarding this preparation is quite sufficient to warrant the Department in not only strongly advising farmers not to purchase the "Anconia" dip, but also in warning merchants and storekeepers against accepting agencies for it and stocking it.

This case is similar to one which recently occurred in South Australia, where a preparation called the "Merino non-poisonous sheep and cattle dip" was temporarily placed upon the market. Particulars of this are in the hands of the Department, and the following remarks regarding it, made by the Minister of Agriculture in the South Australian Parliament, may be quoted: "The Minister of Agriculture said he was sorry to say that a great deal of the stuff placed on the market was absolutely worthless. People might just as well dip their sheep in water. If the Government could take action it would do so. He warned pastoralists and others that to purchase the particular dip to which he had referred was only a waste of money. It was a fraud."

The whole matter of the "Anconia" dip is being followed up, and further information will be published in a later issue of the *Journal*. Meanwhile, both mercantile men and sheepowners should act on the foregoing warning.—*C. J. Reakes, D.V.Sc., M.R.C.V.S., Director, Live-stock Division.*

NOTE.—Since the foregoing was written a report in the *New Zealand Herald* of the 13th March, 1918, states that in a civil action for debt brought against a firm trading as John Harrison and Co., of Auckland, a sworn declaration alleged that J. C. Harrison had surreptitiously left New Zealand. It was stated in evidence that this individual had recently started in business in Auckland as a manufacturing merchant, selling a sheep-dip called "Anconia."—EDITOR.

Maple-trees are being grown at the Royal Botanic Gardens, Kew, for the purpose of transplanting to places in France where Canadian soldiers lie buried. The work is being carried out in co-operation with the Canadian Department of Agriculture, which gathered and forwarded the seed to England from Canada.

ANSWERS TO CORRESPONDENTS.

IN every instance a question to which an answer is desired in the *Journal* must be accompanied by the full name and the postal address of the inquirer, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

POLLARD AND POULTRY-FEED.—SORREL-SEED FOR PIGS OR POULTRY.

"CHICKEN," Methven :—

1. As a feed for poultry, please say whether it is worth while giving 10s. 6d. or 11s. a sack for what the millers are putting on the market as pollard. It is obviously nearly all bran cut up finely.

2. Is sorrel-seed, either in its natural condition or scalded or boiled, suitable feed for pigs or for poultry?

The Live-stock Division :—

1. The quality of much of the pollard on the market of late has been so inferior that its use cannot be recommended at the high prices asked for it. A better proposition is to substitute wheat-meal for pollard.

2. Sorrel-seed cannot be recommended as a suitable feed for either pigs or poultry—under any condition.

GRASSING MANUKA LAND IN HAWKE'S BAY.

J. G. S., Waipawa :—

What do you consider a suitable grass-mixture to sow on manuka land felled and burned? The land is of fair quality, situated on the east coast of Hawke's Bay.

The Fields Division :—

On land such as described it is assumed that *Danthonia pilosa* will finally become the dominant grass irrespective of what grass-seed mixture is used, unless, of course, scrub or fern makes its appearance. The main problem appears to be what is the best mixture to use in order that some of the better sown grasses may form a component part of the grass land after danthonia has obtained a good hold. The three main good grasses that are likely to combine well finally with danthonia are cocksfoot, crested dogstail, and *Poa pratensis*. *Poa pratensis* is especially valuable, not so much from the feed point of view as from its compacting the turf and rendering cocksfoot likely to be permanently profitable. So far as crested dogstail is concerned, there is a general prejudice against the grass owing to its low yield, but, low yield or not, an increase in dogstail in a pasture is usually reflected in the excellent condition of the sheep carried. Of course, for poor ground of the nature described there are many grasses, such as brown-top, chewings fescue, ratstail, &c., but in general their feeding-value is less than that of danthonia. So far as danthonia itself is concerned, there should be no need to sow any, as stock will readily secure its distribution. The following general mixture is suggested: Rye-grass (perennial), 12 lb.; cocksfoot, 8 lb.; crested dogstail, 3 lb.; white clover, 1 lb.; *Poa pratensis*, 2 lb.; English trefoil, 2 lb.: total, 28 lb. per acre. This mixture may not meet with general approval, and it will be said by some that the seeding is too heavy, especially considering the amount of cocksfoot used. The objective, however, is to finally secure a good mixed danthonia pasture instead of a pure danthonia one, which is so often the case when a light seeding with a minimum of cocksfoot is used. There is a grass, *Poa nemoralis*, that is giving excellent results on scrub land in Hawke's Bay, but the present price of the seed quite precludes its general use.

PRESERVING BUTTER IN JARS.

E. M. M., Waimate :—

Kindly advise me as to the method of salting butter in jars. Would the butter keep if only a small quantity were put down at a time—say, 4 lb. or 5 lb. a week—till the jar was full ?

The Dairy Division :—

When it is intended to hold butter for a lengthy period in jars it is advisable to add from ¾ oz. to 1 oz. of salt to each pound of butter. The cream from which the butter is churned should not be allowed to become oversour, and it should be churned at as low a temperature as possible. The churning process should be stopped when the butter-grains have formed. Care should be taken to free the butter from all traces of buttermilk by thoroughly washing with very cold water. The butter will be likely to keep longer if each churning is packed in a small jar instead of filling the larger one from week to week until the jar is full.

STORING WINTER APPLES.

E. S., Tauranga :—

What is the best way to store winter apples of the Dougherty and American Horn varieties ?

The Horticulture Division :—

The best method of storing apples is to place them on benches in a rat-proof shed which is dry, dark, and with a fair amount of ventilation near the top. The best shed is one built to support a double wall of fine-meshed wire netting filled with clean straw, and the top thatched with straw and wire netting also.

WHEAT EAR-BLIGHT IN CANTERBURY.

D. C. D. THOMAS, Westerfield, Ashburton :—

Under separate cover I send you a few stalks of wheat taken from my paddock at Westerfield. You will notice that the heads have all blighted off. It would be interesting to know—(1) whether the paddock would be infected with the same blight next year ; (2) would it be safe to sow wheat harvested from an infected paddock ; (3) the remedy, if any. Most of the farmers in my district have crops more or less badly infected. I have one paddock of 90 acres which two months ago promised to be a 45-bushel crop, and just as the wheat was about to change colour the black heads appeared. I have now reaped this particular crop, and will be very lucky if it threshes 20 bushels.

The Biologist :—

The specimens have the heads covered with a fungus known as wheat ear-blight (*Sphaerella tuslasnii*). This fungus has been exceedingly prevalent this season, and seems to have been the cause of the excessive amount of shrivelled wheat produced. There is no practical method of control, and it is only in exceptional years that any great trouble is caused. Wheat from diseased crops is not said to have any effect on development of the trouble, this being a matter connected entirely with weather conditions.

ARSENICAL COMPOUND FOR SHEEP-SKINS.

"SUBSCRIBER," Dargaville :—

Kindly inform me what the arsenical mixture is for painting sheep-skins after they are flayed, as mentioned in the last January *Journal*, page 60, under the heading of "Care of Skins."

The Live-stock Division :—

Any of the recognized arsenical sheep-dips will meet requirements, but the compound is to be used four times the strength prescribed for sheep-dipping purposes.

CONTROL OF YARROW.

A. B., Waituna :—

Yarrow is very common in one of my oat-paddocks this year. Would it detrimentally affect the feeding-qualities of the chaff? I tried the horses with a sheaf of the oats, and they left all this weed and cleaned up every straw of the oats. Could you suggest means to eradicate the yarrow if it is of no value?

The Fields Division :—

Yarrow (*Achillea millefolium*) does not really detrimentally affect the feeding-quality of oaten chaff, but horses generally reject it. In Canterbury, on short-rotation grass land where a cropping system is intercalated between each period of grass, yarrow is often a very bad weed, occupying large areas of the pasture after the third or fourth year. The best system of control is to winter-plough and let the furrow-slices dry out thoroughly during the summer, so as, if possible, to kill out the weed. Then in midsummer, after rain, work down the land, and sow in the autumn with a cereal, either wheat or Algerian oats. If the spring and early summer are fairly wet, however, this system will be quite a failure. Under such circumstances the repeated use of the cultivator and harrows will be necessary, with raking up and burning of the underground stems. The use of another crop, such as tares sown about the middle of December, is suggested. These could be eaten down and the ground worked up for winter wheat. If the ground is not very badly infested with the weed a fair amount of spring work may reduce it sufficiently to sow down rape and grass. If such is done the seed-mixture should contain a good proportion of clover.

SIGNS OF PREGNANCY IN FARM ANIMALS.

"SUBSCRIBER," Clive.

What is a sure way of telling when a sow is in pig or not?

The Live-stock Division :—

There is no sure way of determining in the early stages whether a sow has conceived or not, other than that of ordinary observation for the usual signs recognized by practical men. The same holds good with other animals until manipulation can be resorted to.

LIMING AND HARROWING LUCERNE.

"LUCERNE," Miller's Flat, Otago :—

In the case of lucerne sown last November, and which is becoming choked with sorrel, would I be safe in top-dressing with burnt lime instead of carbonate of lime?

The Fields Division :—

Burnt lime may be used as a top-dressing for lucerne, in quantity not exceeding 15 cwt. per acre. A good harrowing would appear to be in order. You would injure some of the lucerne thus, but the sorrel would get the worst of it.

RECLAMATION OF TIDAL LAND.—ORCHARD COVER-CROP.

"SUBSCRIBER," Clive :—

1. I have about an acre of low-lying land over which brackish water flows in parts during spring tides; rushes are growing on it at present. What is the correct way to bring it into grass, and what grass will grow on it?

2. What is the best cover-crop for a young orchard, to keep down the weeds and at the same time provide winter feed for cows?

The Fields Division :—

1. The grassing of such lands as you describe will depend largely upon the amount and saltness of the brackish water. If the land can be kept quite clear of brackish water by suitable stop-banks much of the land in the Clive district now carrying rushes would grow excellent lucerne, but this, of course, presupposes

the easy removal of the rushes and the practicability of cultivation methods. If the land cannot be ploughed, then grassing of any nature will be almost impossible, but a certain amount of good might be done by burning the rushes and surface-sowing with a mixture somewhat as follows: Fiorin, 5 lb.; Indian doob, 5 lb.; *Lotus major*, 1 lb.; strawberry-clover, ½ lb. Strawberry-clover does excellently on salty soils near the sea, but its present price is almost prohibitive. If the land can be ploughed a good permanent turf—but not of any great annual yield—will be secured by using the above mixture sown at the rate of about 18 lb. per acre.

The Horticulture Division:—

2. Oats and tares, or oats and field-peas, are recommended for the double purpose mentioned.

ESTABLISHING LUCERNE.

"Lucerne," Auckland:—

I have a 10-acre piece of land which I intend to sow with lucerne next spring. This summer it has a crop of soft turnips, which is just being fed off with young cattle. I wish to know what would be the best treatment to give it in order to prepare it for the lucerne-seed next spring. My idea is to apply 1 ton per acre of carbonate of lime and sow a green crop for feeding off. If this is suitable, what would you recommend for sowing? The soil is good rich loam, varying to light, the subsoil is free. There is some sorrel and white clover, and timothy and cocksfoot are rather persistent, but otherwise the land is fairly clean.

The Fields Division:—

It is suggested that you apply the lime after the soft turnips are fed off. Plough with an ordinary furrow, and cultivate for Algerian oats or Black Skinless barley for green feed, the latter for preference, the ground being subject to sorrel-growth. Plough 1 in. deeper in spring; this will bring the lime to the surface again, at the same time mixing it with the soil. Keep the ground clean, but postpone sowing until November. It is essential that the conditions be favourable for bringing the lucerne rapidly away from sorrel and white clover, as these are bad pests of young lucerne. These conditions are most likely to be observed by sowing in the month suggested. For the same reason it will probably be necessary to go over the stand with tine harrows from time to time during the succeeding winter and spring.

TREATMENT FOR LIGHT LAND IN POVERTY BAY.

C. W. F., Ngatapa, Gisborne:—

I have some low hill country of a light sandy nature in native grass, and should be glad of advice as to treatment for same, also the kind of grasses I could use. Some of the country is ploughable and some is not. Please stipulate treatment for ploughable and unploughable country separately.

The Fields Division:—

If the native grass (danthonia mainly, in all probability) forms a fairly good turf, top-dressing with basic slag or some other phosphatic manure would most likely be the best procedure to adopt, but at the present time the price would preclude this treatment. So far as surface-sowing is concerned, the land should be spelled in the late summer and burnt when the grass is dry. Surface-sowing should immediately follow this operation, using a mixture somewhat as follows: Perennial rye-grass, 6 lb.; cocksfoot, 4 lb.; crested dogstail, 1 lb.; white clover, ¼ lb.; English trefoil, ½ lb. If the native grass is very thin, the amount used per acre might be increased to about 18 lb. If the land is ploughed it can be either put straight into grass or some annual crop taken off first. If the immediate sowing of grass is adopted the land should be ploughed, disked if necessary, harrowed and rolled, and the grass-seed brush-harrowed, and again rolled. The seed-mixture suggested is—rye-grass, 14 lb.; cocksfoot, 10 lb.; crested dogstail, 3 lb.; *Poa pratensis*, 1 lb.; white clover, 1 lb.; red clover, 2 lb. It is probable that ½ lb. of turnips and ½ lb. of rape would be an advantage for the rapid production of winter feed. If cropped before sowing down to grass, a crop of turnips, followed by oats spring-sown would be suitable, and then laying down to grass

after the oat-stubble had been worked up. The amount of cultivation necessary for grass-seeding would depend on the condition of the ground, but probably disking, harrowing, and rolling would be sufficient. As an alternative, an oat crop (Algerian) winter-sown might be grown, and the land laid down to grass the following February or March, with much the same treatment as suggested above, and the employment of a similar grass-mixture. It is possible that growing of annual crops previous to laying down will result in a great increase in sorrel, and, if this is likely, direct sowing of the grass without any cropping is best. If any cropping is done, the important thing to remember is that the grass-seed must be autumn-sown, and any cropping rotation must be regulated with this end in view.

CURING SKINS AND HIDES FOR FARM USE.

THOMAS B. FEATHER, Waitekauri, Waikino :—

Kindly advise as to the best known method of curing cattle-hides for use on the farm for harness, &c.; also goat-skins for laces, &c.—leather being now so expensive to buy.

The Live-stock Division :—

For the curing of skins the following is the procedure recommended: First trim all ragged edges, and remove as much flesh, fat, &c., as possible, without damaging the pelt. Next place the skin on the floor or other flat surface, and wash the wool with warm water and soap, and then clear water; remove all surplus water from the wool by scraping or squeezing with a smooth board. Take up the skin and shake it well, then place it fleece down on a clean surface, and take a good handful of alum, to which a little salt may be added, proceeding to rub it well into the pelt with a rotary motion over all the surface equally; next fold up the skin, fleece outward, and let it stand for three days. Open and hang the skin for a while, and then commence to scrape the pelt with a furrier's knife, always scraping in the same direction; three scrapings are needed to properly finish the pelt. With different skins discretion must be used in treating strong- or weak-fibred pelts. With regard to hides, the removal of hair is done by soaking the hides in lime-water until the hair is easily removed—say, for three or four days. The proportion of lime to be used is 1 pint of burnt lime to 10 gallons of water. Further treatment is on similar lines as in dealing with skins.

NOTICE.—Answers cannot be given to queries by F. W. M., Opawa, and "Subscriber," Omarama, unless they supply their names to the Editor.

FORTHCOMING AGRICULTURAL SHOWS.

Hawarden A. and P. Association: At Hawarden, 28th March.
Oxford A. and P. Association: At Oxford, 4th April.
Methven A. and P. Association: At Methven, 11th April.
Otago A. and P. Society: Winter Show at Dunedin, 28th to 31st May.
Waikato Winter Show Association: At Hamilton, 4th to 8th June.
Manawatu and West Coast A. and P. Association: Winter Show at Palmerston North, 18th to 21st June.

A DECADE OF WORLD AGRICULTURE.

THE "INTERNATIONAL YEAR-BOOK OF AGRICULTURAL STATISTICS.'

THE latest-received issue of the "International Year-book of Agricultural Statistics," which covers the decennial period 1907–16, may fairly claim to be the most complete work of the sort in existence. It is the result of the most extensive and at the same time detailed research yet devoted to this subject, and it is safe to say that no organization but the International Institute of Agriculture, of Rome (in which New Zealand has official membership), could have produced such a work.

The volume comprises over a thousand pages, and its 836 statistical tables are replete with every sort of information on the subjects dealt with. In due sequence are furnished all the available data regarding areas cultivated in each country, the total yields realized, and the yields obtained on a given standard of area. Besides this, the Year-book includes the five-years and ten-years averages for the period covered, so that readers can ascertain at a glance whether in any particular year cultivation has extended or has been restricted in a given country, and whether the results have been favourable or the reverse.

The first products to be considered are the cereals, as naturally being of capital importance for food. It is shown that the ascertainable annual yield of wheat throughout the world exceeds 1,000 million quintals,* and represents at present value more than £2,000,000,000; the yield of maize is nearly as large as that of wheat, and is worth £1,000,000,000; while the aggregate value of the six chief cereals (wheat, rye, barley, oats, maize, and rice) is not less than £6,000,000,000 yearly.

The yield of potatoes is over 1,500 million quintals, and that of sugar-beet is more than 500 million quintals. Every year the world has at its disposal a total of 150 million quintals of beet and cane sugar, nearly 150 million hectolitres of wine, 10 million quintals of coffee, more than 8 millions of leaf tobacco, and nearly 1 million quintals of hops.

Textile industries account annually for nearly 50 million quintals of cotton, 8 million quintals of flax, and 7 million quintals of hemp, while silkworm-breeders in Europe and Asia deliver to the trade more than 200 million kilogrammes of cocoons. The raw material for vegetable-oils comprises yearly throughout the world an aggregate of 30 million quintals of olives, and a similar quantity of linseed, 4 millions of hemp-seed, and 5 millions of rape-seed.

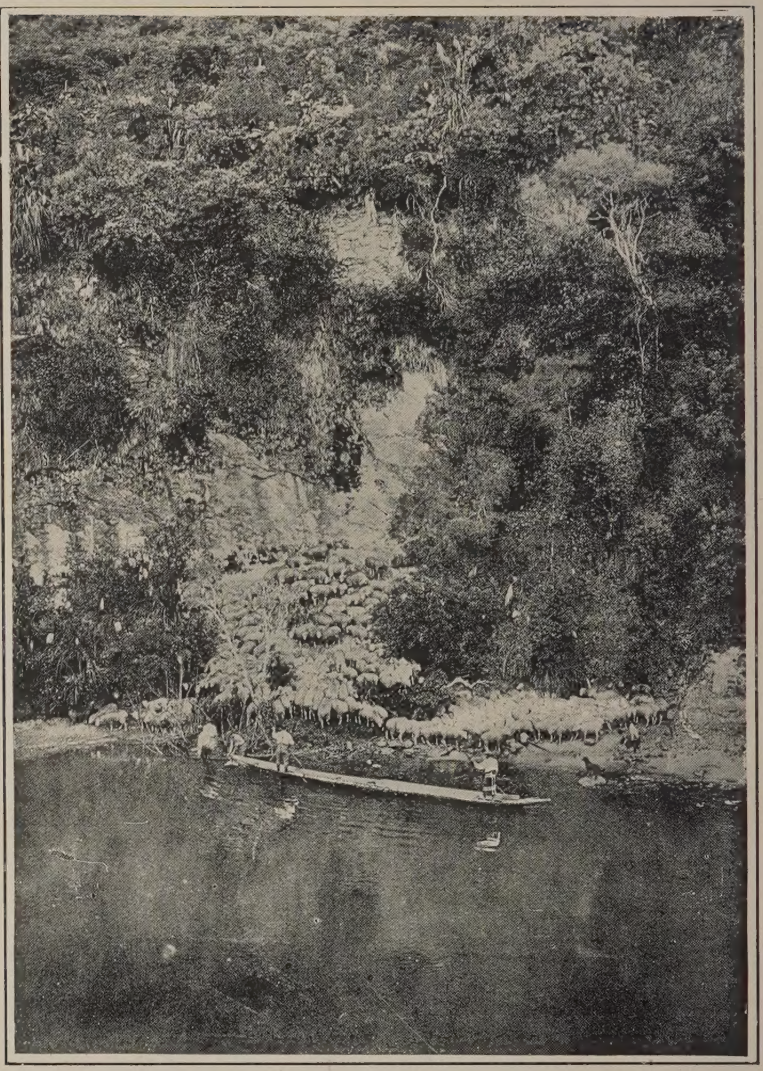
Turning to live-stock, the Year-book gives for each of the ten years comprised the numbers of horses, asses, cattle, sheep, pigs, &c., in eighty-two countries taken singly, and afterwards reckoned out as compared with each thousand inhabitants of the country, both at the opening and at the close of the period under review.

Having given, by means of a large number of tables, the imports and exports of the products previously considered as to yield, and showing the origin and destination of these imports and exports as regards each country, the Year-book deals with the question of consumption, also for each country. The prices of the chief products, on spot and for forward or future delivery, form a special section, where are found all the data for a detailed examination of the market fluctuations in recent years, inasmuch as weekly quotations are recorded in respect of the chief products. This section also comprises tables of rates of freight and of exchange.

There follows a section on fertilizers and chemical products employed in agriculture, including the data of production, trade and consumption, with market quotations for phosphatic, potassic, and nitrogenous fertilizers, for sulphur and sulphate of copper. These materials give rise to a very large and active trade, and whole fleets are in request for their transport to the localities where they are consumed, this being particularly the case with natural phosphates and with nitrate of soda.

The Year-book should specially appeal to agricultural organizations, and to progressive business men in the various trades and industries related to agriculture, also to many educational bodies. The publication is in French (*Annuaire International de Statistique Agricole*), but includes English tables of contents, and owing to the straightforward nature of the matter it presents no serious linguistic difficulty. The price is 8s. post free from the Publications Service of the International Institute of Agriculture, Rome.

* Ten quintals is approximately equal to one ton.



On the Upper Wanganui.